RADIOLOGY

A MONTHLY JOURNAL DEVOTED TO CLINICAL RADIOLOGY AND ALLIED SCIENCES

EDITOR

Howard P. Doub, M.D.
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DR. AUGUSTUS W. CRANE
Pioneer Radiologist

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Dr. Augustus W. Crane: 1868–1937[1]

HOWARD P. DOUB, M.D.

Detroit, Mich.

THERE IS A twofold satisfaction in carrying out the assignment which Dr. Pendergrass has given me. It affords me the opportunity to express my wholehearted support of an annual lecture devoted to men and events that have shaped radiologic history and have laid the broad foundations of radiology. It is a pleasure, also, to pay tribute to a Michigan radiologist who was not only a great scientist and investigator but who, by the very strength of his character, was a leader in establishing our specialty in America.

Dr. Augustus W. Crane was born in Adrian, Mich., on Nov. 13, 1868. His education was acquired in his native state and culminated in his graduation in medicine from the University of Michigan in 1894, as valedictorian of his class, following which he entered the practice of medicine in Kalamazoo, Mich. He became interested in laboratory procedures, and in 1895 was appointed city bacteriologist, the first in the state. This early devotion to clinical medicine remained with him throughout his life. When he delivered the Caldwell Lecture in 1932, he chose as his subject: "Roentgen Ray Findings and the Clinical Background," and in the course of his address stated that he had watched the roentgenologist evolve from clinician to specialist to technician and hoped to see his feet again planted firmly on the ground of clinical roentgenology. He warned, also, that if the roentgenologist did not remain a clinician, the clinician would become the roentgenologist.

In a personal letter to Dr. P. M. Hickey, dated Nov. 3, 1927, Dr. Crane detailed some of his earliest experiences in roentgenology. In March 1897, he installed his first x-ray machine, consisting of a 12-inch coil with a hammer make-and-break on 10 to 15 volts and 20 amperes. This was actuated by a bichromate battery of 6 cells, which he constructed. In 1897, he devised a fluoroscopic screen by mounting the screen in a picture frame with a heavy glass front. At the same time he enclosed the tube in a box lined with glass. To this unpremeditated protection, he believed he owed his life.

In 1899, Dr. Crane published a scholarly and forward looking article in the *Philadelphia Medical Journal*, entitled "Skiascopy of the Respiratory Organs." This article stamped him as one of the most brilliant of the early investigators in roentgenology and won him international attention. Shortly thereafter he was elected to membership in the London Roentgen Ray Society and in 1902 he contributed the section on X-rays in Medical Practice in the English work by David Walsh. His

[1] Presented at the Fortieth Annual Meeting of the Radiological Society of North America, Los Angeles, Calif., Dec. 5–10, 1954.

contribution to the *Philadelphia Medical Journal* was the first comprehensive roentgen study of the chest and marks its author as the outstanding pioneer on this subject in America. It will be found to be pleasant and worth-while reading by all students of pulmonary roentgenology. (Extracts from the original article were republished in the *American Journal of Roentgenology* **3:** 419–430, 1916.) In this article, also, many of the roentgen developments of later years were anticipated. The skiameter which Dr. Crane constructed by pasting thin lead strips on a card for measuring movement and density during fluoroscopy was clearly the forerunner of the modern fixed grid and kymograph.

In the same year, 1899, Dr. Crane began work on adapting the "Wehnelt" electrolytic interrupter for use on alternating current. This resulted in the first electrolytic interrupter to operate an x-ray coil on alternating current in America. An account of this work was published in the *Philadelphia Medical Journal* in 1902, and the device is described by Pusey and Caldwell in their book, "The Roentgen Rays in Therapeutics and Diagnosis," published in 1903. The coil, which was made for 15-volt direct current, soon broke down, however, under use on 110-volt alternating current, whereupon Dr. Crane rewound the primary, using fewer turns, and immersed the entire coil in transformer oil, after which it ran with increased power for many years.

One of the prominent characteristics of the early roentgenologists was their ability to adapt or invent apparatus to fit their particular needs. In this society of practical geniuses, Dr. Crane was easily a charter member. Mention has been made of his use of alternating currents with coils. This was followed by his wax transformer, which later gave him the idea of the autotransformer. He had one constructed and it is thought to have been the first autotransformer to be installed on an x-ray machine. He devised, also, a unique, practical, and durable high-tension switch, making it possible to operate multiple tubes from one transformer. This was in use in his private office until his death. Many other devices of a practical nature were likewise attributable to him, some of which were later developed by commercial concerns.

It is indicative of the versatility of Dr. Crane's talents that he invented and patented, Oct. 14, 1913, a mechanical self-starter for an automobile engine. The fate of this venture is not known to the writer.

Dr. Crane's inventions were invariably an outgrowth of the necessity to produce the better technical results which he demanded in his work. He was above all a clinician, who insisted upon the correlation of the clinical with the roentgen findings. In this field he was well grounded, for during his early professional life he carried on private practice in internal medicine and only later restricted his work to consultation, in which roentgenology claimed his dominant interest.

Dr. Crane was a pioneer in gastro-intestinal roentgenology. His first plates of the stomach and colon were made on Dec. 8, 1905. These he followed by studies on the position and shape of the stomach and intestines. In 1907 he published two articles on gastric ulcer and in 1908 he presented a paper on gastric cancer before the American Medical Association. He is also remembered by the "Crane string sign," which he described in mucous colitis.

Dr. Crane was perhaps most interested in his studies of the lungs and heart, at least in his earlier years. We have already mentioned the outstanding work on the chest, in 1899, which made him known internationally. Later he contributed numerous articles on pulmonary roentgenology. In 1918 he described the inverted comma sign as early evidence of pulmonary tuberculosis. He was one of the early workers with kymography. In 1916 he read a paper before the American Medical Association on "Roentgenocardiograms." He employed a home-made device for his studies, which he believed would aid in the understanding of cardiac physiology

and pathology. A much more complete study of roentgenology of the heart was given as his presidential address before the American Roentgen Ray Society in 1916.

In his later years Dr. Crane produced a series of articles which revealed his deep interest in, and knowledge of, the basic studies leading to Roentgen's discovery of the x-rays. In an editorial appearing in 1930, entitled, "The Mathematical Discovery of the X-rays," he pointed out that Helmholtz in 1893 had published his electromagnetic dispersion theory of the spectrum and provided, on purely mathematical grounds, the exact space which we now know to be occupied by the roentgen rays. In 1933, he published a detailed account of the work of Francis Hauksbee, who in 1709 conducted the first experiments on excitation of a vacuum tube by an electrical machine, which eventually led to Roentgen's discovery. In 1933, also, in a paper presented before the American Congress of Radiology, entitled, "The Research Trial of the X-ray," Dr. Crane painted a fascinating picture of the centuries of experimental work which led to the discovery of the x-rays and on to the present atomic age. He closed with a prophetic statement: "If the future is to repeat the past, then succeeding generations will look back on Millikan and his confreres, not as completing the conquest of that last frontier of the spectrum, the cosmic waves, but as opening a trail to frontiers yet unseen." This series of papers will intrigue those who are interested in the historical aspects of radiology.

It was inevitable that a man of such attainments should be honored by his fellow radiologists. Dr. Crane was President of the American Roentgen Ray Society in 1916 and was the Caldwell Lecturer in 1932. He was Acting Editor of the *American Journal of Roentgenology* in 1917–18. He was the recipient of the Gold Medal of the Radiological Society of North America in 1921. In 1932, the University of Michigan awarded him the honorary degree of Master of Arts. It was at this time that an Editorial in the *Journal of the Michigan State Medical Society* called attention to his remarkable literary attainments. The Editor wrote: "It is as a master of English prose that we wish particularly to commend Dr. Crane. He has a faculty, unfortunately too rare, of adding interest to any subject on which he essays to write. He possesses a scientific imagination and a mastery in the use of metaphor. His papers are characterized by simplicity and clearness, as well as harmony in his choice of words of which he has great verbal wealth." A few quotations serve to illustrate this gift of expression. "The discovery of roentgen rays was unexampled in dramatic surprise and promise." "The miracle of shadows by invisible light gave increasing power and precision to diagnosis." "It is the part of the pioneer to brave dangers and hardships. In this far region of the spectrum were lurking unknown dangers, unseen, insidious, deadly."

The private life of Dr. Crane was as exemplary as was his scientific career. He was blessed with a happy home. Mrs. Crane was a minister of the Gospel, who was well known as a leader in forward thinking. A son, who is now a respected medical practitioner of Kalamazoo, and a daughter completed the family circle.

Dr. Crane was always a leader and never a follower. He was impatient of conventionalities and restraint and would brook no interference in his search for the basic truth of any problem. His profession was paramount to all of his activities. He was an untiring worker, not only in his daily professional practice, but also in his literary work, which was often done at the expense of needed vacation time. On the day of his death he had just completed the plans for a roentgen installation and ordered the new equipment. That evening he was writing for publication a memorial to his friend, the late Dr. P. M. Hickey, when death overtook him (Feb. 20, 1937). A bibliography of his published works is appended.

In contrast to his rigid scientific work,

Dr. Crane occasionally indulged in recreations such as chess, bowling, golf, and trout fishing. In these fields he exhibited the same skill which characterized his more serious activities, rolling two perfect games while bowling, and playing golf in the eighties. He was a lover of the undefiled out-of-doors, which accounts for his later devotion to trout fishing.

Such was the life of Dr. Augustus W. Crane, whom we honor for his contributions to radiology. We who follow in the path of this radiologic pioneer are richer because of his diligence and his insistence that clinical medicine is the basis of radiologic practice. He has left us as a heritage the example of a physician with a brilliant mind used in the development of the science of radiology for the betterment of his fellow man. His was the life of the busy practitioner of medicine, whose clinical interests led him into the bypaths of abstract science.

From my study of the life of Dr. Crane, I have been increasingly impressed by his breadth of vision and strength of purpose. I deem it a privilege to have known him when he was at the peak of his distinguished career, and to have the opportunity to present, even though inadequately, some of the highlights of his life.

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SUMARIO

El Dr. Augustus W. Crane

En este trabajo, presentado ante la Sociedad Radiológica de Norte América, en su Sesión Anual de 1954, se rinde tributo al Dr. Augustus W. Crane (1868–1937), radiólogo del Estado de Míchigan, E. U. A., que fuera no tan sólo un gran técnico e investigador, sino también por la misma entereza de su carácter, uno de los portaestandartes en el establecimiento de la radiología en las Américas.

Fué el Dr. Crane primordialmente un clínico y, aunque dotado de mucha capacidad mecánica e ingenioso en lo relativo a inventar aparatos en los primeros días de su especialidad, realizó esto siempre a fin de poder producir los mejores resultados técnicos que exigía en su práctica. Publicó en 1899 lo que fué probablemente el primer extenso estudio roentgenológico del tórax y obtuvo las primeras placas del estómago y del colon en 1905. Su gran interés radicaba en los pulmones y el corazón, y fué uno de los primeros que se dedicaron a la quimografía.

El Dr. Crane fué autor dotado de ricas prendas, habiendo preparado algunos trabajos sumamente interesantes acerca de los desenvolvimientos que condujeron al descubrimiento de los rayos X y acerca de los aspectos históricos de la radiología.

Arthrogryposis Multiplex Congenita[1]

HAROLD G. JACOBSON, M.D., F.A.C.R.,[2] EARLE A. HERBERT, M.D.,[3] and MAXWELL H. POPPEL, M.D., F.A.C.R.[4]

ARTHROGRYPOSIS multiplex congenita, or amyoplasia congenita, was probably first described by Otto in 1841 (1). Rocher (2) collected 31 cases of the disease from the literature in 1913, giving it the name of multiple congenital rigidities. Stern (3) introduced the term arthrogryposis multiplex congenita in 1923. In 1932, Sheldon (4) suggested the shorter designation, amyoplasia congenita. Further descriptions and case presentations followed, by Steindler (5), Hillman and Johnson (6), Badgley (7), and others.

CLINICAL FEATURES

Arthrogryposis multiplex congenita is present at birth and is recognizable by the presence of flexion and/or extension contractures of a few or many of the joints of the extremities. In many cases all four extremities are affected; in other instances a single limb is involved. Brandt (8) has stated that the infant looks like a wooden doll. The disease is generally symmetrical and is probably the result of incomplete development or failure of development of one or more muscle groups during intra-uterine life. It is generally stated that the muscles of the trunk and head are spared, but Adams, Denny-Brown, and Pearson (9) claim that the erector spinae muscles may be involved, with resulting scoliosis, and Ealing (10) described a case with rigidity of the temporomandibular joints. Generally, the affected limbs are small in circumference and the joints, by contrast, are unusually large. Complete ankylosis is uncommon; usually, some slight joint motion, both active and passive, is possible. Muscular weakness and hypotonia are prominent features in most instances. The muscles are generally quite thin; frequently they cannot be felt at all. Electrical reactions are usually feeble or absent, but the reaction of degeneration is not observed. As a rule, tendon reflexes cannot be obtained. The skin and subcutaneous tissues are thickened, wrinkled, and flabby, with general nutrition below normal. Luxations and subluxations of many joints may occur. Associated anomalies include webbed fingers, polydactyly, hydrocephalus and other malformations of the skull, absence of the sacrum and of the patella, Klippel-Feil syndrome, Sprengel's deformities, clubfeet, clubhands, and acetabular dysplasia.

Steindler classified the disease into three general groups:

1. *Extension contractures* involving the knees, the elbows, or all four extremities. In this group the extremities are usually fixed in extension, abducted, and outwardly rotated. Clubfoot deformities, congenital dislocation of the hips, and absence of the patellae may occur concomitantly.

2. The *flexion type*. Here the hips are abducted, with outward rotation in flexion, and are often subluxated or dislocated. The flexion of the knees is so severe that the heels can almost touch the buttocks. The legs are frequently externally rotated.

3. The *mixed group*. In this group, which is the most frequent, a combination of flexion contractures of the elbows, wrists, and hips, and extension contractures of the knees occurs.

In a review of 66 cases, Steindler found the disease to be more frequent in males

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[3] Resident in Radiology, New York Hospital-Cornell Medical Center.

[4] Director, Departments of Radiology, Bellevue and University Hospitals, New York, and Professor and Chairman of the Department of Radiology, New York University College of Medicine.

than in females, with a few cases showing a familial incidence. He stressed the tendency for recurrence of the contractures after correction.

The roentgen findings in arthrogryposis multiplex congenita have not been emphasized, the present paper being the first on the subject to appear in the American radiological literature. Muscle bundle atrophy is said to be a prominent roentgenologic feature. The presence of osteoporosis has not been stressed. When it occurs, it is said to be due to a lack of ambulation.

ETIOLOGY

Adams, *et al.*, felt that not all of the cases classified as arthrogryposis congenita are alike and that they may not represent a single pathologic entity. Actually, the cause is obscure. Most authors, except for Steindler, doubt any hereditary or familial incidence. Adams and his associates considered the most likely explanation of the contractures to be a congenital defect in the development of the anterior horn cells caused by chronic degeneration of these cells during fetal life. They postulated failure of innervation of the affected skeletal muscles, with the maintenance of a fixed position *in utero*.

Hillman and Johnson believed that the condition could hardly be intrinsic, as a chromosomal defect or a mutation of a normal ovum, since they saw two sets of identical twins with one child of each set normal and one presenting arthrogryposis. They were of the opinion that the stiff joints are the result of loss of muscle function, that they are intrinsically normal and become fixed by periarticular adhesions resulting from lack of motion secondary to loss of muscle power. They pointed out that the attitude of the arms and legs resembles strikingly the fetal attitude of the limb buds prior to rotation.

Badgley attributed the disease to a vascular fault or a neurovascular abnormality. He believed that the normal anlage for muscles was present but, because of improper timing in the appearance of the vessels entering the limb buds, or because of interference with proper vascularization, anoxia and muscle death resulted. He found that the blood vessels in the involved extremities were quite small in caliber and felt that contact points of pressure in the uterus might produce such diminished vascularization. He postulated that this diminution in blood supply corresponded with loss of function in varying muscle groups.

Stern advanced three possible causes for congenital arthrogryposis: (*a*) maldevelopment of the ovum, (*b*) intrauterine joint disease, such as periarthritis, and (*c*) intrauterine pressure or forced intrauterine position.

Jansen (11) suggested that the disease may be due to a small amnion with increased hydrostatic pressure. Moore (12) felt that there was a relationship to peripheral nerve change and presented 5 cases in support of this view, including one with café-au-lait spots.

There are several other points of interest in relation to the etiology of arthrogryposis. Roberts (13), in 1929, described a disease in newborn lambs analogous to arthrogryposis, with clear-cut hereditary transmission. Kite (14) in relating arthrogryposis to other anomalies found that 4.5 per cent of his clubfoot series had arthrogryposis.

Actually, the development of the contractures during intra-uterine life is not adequately explained by any of the promulgated theories. Imperfections in embryogenesis appear to account for a large number and variety of anomalies of the skeletal muscles. Some anomalies, such as the congenital absence of certain muscles, may be linked to inherited dystrophic disease, whereas others appear as isolated defects. In connection with arthrogryposis, it should be noted that skeletal abnormalities are prominently found associated with congenital deficiencies of muscles, for obvious reasons. If movement of a limb is not up to standard during the growth period, the skeletal development of that limb must be stunted. In other words,

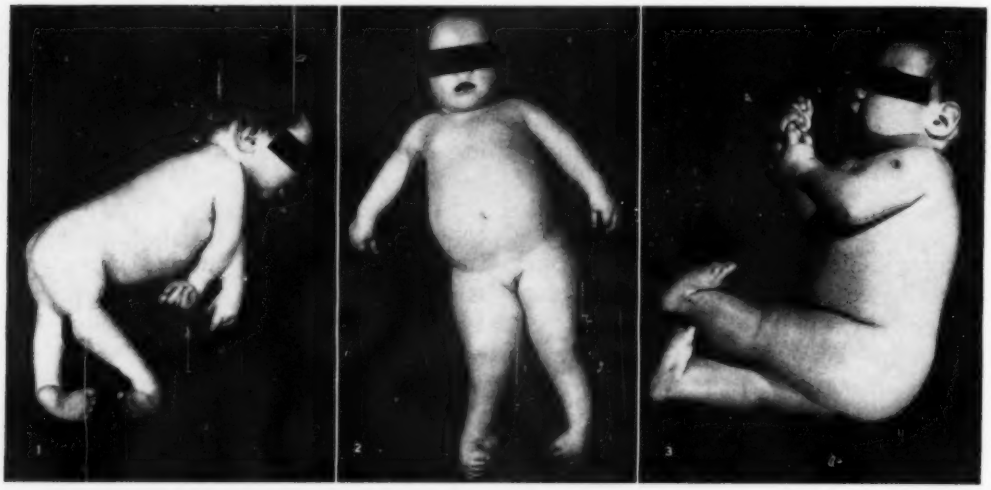

Fig. 1. Photograph of infant (Case 6) showing clubfeet, extension contractures of both knees, flexion contractures of the wrists and hands, and extension contractures of the elbows.

Fig. 2. Photograph of infant (Case 8) demonstrating clubfeet, externally rotated legs, flexion contractures of the wrists with clubhands, and extension contractures of the elbows.

Fig. 3. Photograph of infant (Case 1) showing calcaneovalgus foot deformities, extension contractures of the knees, flexion contractures of the hips, flexion contractures of the hands, and flexion contractures of the elbows.

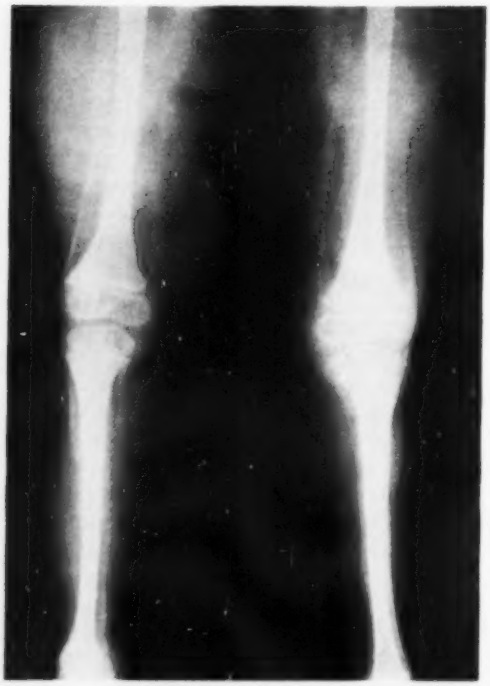

Fig. 4. Anteroposterior roentgenogram of both legs in Case 8, showing extensive muscle bundle atrophy, with aplastic muscle bundles simulating tendon or ligamentous structures. Osteoporosis was present but is not well visualized.

muscular imbalance in the limb must be attended by secondary bone deformity.

PATHOLOGY

Only a few cases are reported in which autopsies or adequate biopsy studies were performed, and these are usually contradictory. In 2 cases presented by Adams and his co-workers, pathologic studies were done and are fully described. The muscles in the contractured limbs were reported to vary considerably. Some muscles were not present at all, either having not developed or having been replaced by fat and/or fibrous tissue. The affected muscles, when present, were of a pale pink color. The most consistent histologic change noted by these observers was diminution in size of the muscle fibers, which ranged from 3 to 5 microns in width and showed a greater variation in size than normal. Generally, the small fibers retained both their longitudinal and transverse striations. These were clear in some parts and indistinct in others. Some muscle groups showed well striated fibers between the atrophic fibers. The endomysial connective tissue was increased

slightly or not at all. Fat cells were numerous in some muscles and not in others. In one of the cases, changes were found in the central nervous system. These involved chiefly the anterior horn cells, which were absent or diminished in number and, when present, were obviously abnormal. Such findings in the anterior horn cells have been substantiated by Brandt and Gilmour (15).

Badgley, in describing the pathologic findings, contended that the muscle fiber changes occurred after development of the mature muscle, claiming that one could see muscle tissue which appeared normal on many tissue sections through the involved muscle groups. The remaining sections showed loss of muscle fibers with replacement by fatty and fibrous tissue. He regarded the muscle lesions as closely resembling the pathological changes seen in Volkmann's ischemic contracture or the early stages of congenital torticollis.

Steindler described degeneration of muscles with replacement by fat masses, with very few muscle fibers remaining, some of which were normal, some attenuated, and others interspersed with degenerated fibrous strands. He felt that the changes probably occur late in embryonal life, when the muscle fibers are fully formed.

CLINICAL MATERIAL

We have collected 13 cases seen at the Hospital for Special Surgery which we believe represent instances of arthrogryposis multiplex congenita. There undoubtedly were other instances of this disease, but we have included only cases with complete charts and unequivocal findings.

Of the 13 patients, 7 were males and 6 females. Twelve were members of the white race, including one Puerto Rican. One was a Negro. Five were of Jewish background. (The significance of this racial distribution cannot be biometrically analyzed, since too many variables are present.) In all of these cases the disease was present at birth.

The type and method of delivery may be of some interest, since in 6 instances delivery was not normal. There were 4 breech presentations, 1 instrumental delivery after prolonged labor, and 1 cesarean section. In 5 instances the delivery was within normal limits. In 2 the record contained no information on this point. Two patients had siblings with similar but milder forms of the disease, but the siblings were not seen at this hospital and could not be studied. One child in the group with known types of delivery was born to a mother with oligohydramnios. It would appear that there may be some relationship between abnormal delivery and arthrogryposis, but no further conclusion is warranted from our material.

TABLE I: CLINICAL AND ROENTGEN FINDINGS AND ASSOCIATED CONDITIONS

Findings	Number of Cases
Muscle bundle atrophy	13
Osteoporosis	13
Flexion and/or extension contractures	13
Clubfeet	10*
Acetabular dysplasia, congenital hip dislocation	7
Calcaneovalgus deformity	4*
Clawhand	3
Genu valgum	3
Anomalies of spine	3
Coxa vara	2
Tibial and fibular bowing	2
Scoliosis	2
Fractures	2
Chest deformity	2
Finger anomalies	2
Elbow subluxation	2
Hernia	2
Rigid facial appearance	2
Knee dislocation (bilateral)	1
Meningocele	1
Portwine stains on face	1
Café-au-lait spots	1
Erb's palsy	1
Cryptorchidism	1

* One unilateral.

We have listed in Table I, in order of frequency, the clinical and roentgen findings. It will be seen from this table that muscle bundle atrophy, osteoporosis, and flexion and/or extension contractures occurred in 100 per cent of the cases. Clubfeet occurred in 10 of the 13 cases, and congenital hip dislocation in 7. In decreasing frequency, there follow such abnormal findings as calcaneal valgus foot deformity, clubhand, genu valgum, coxa vara, scoliosis, spinal anomalies, etc.

TABLE II: DISTRIBUTION AND TYPE OF CONTRACTURES AND OTHER RELATED JOINT FINDINGS

Case	Ankles and Feet	Knees	Hips	Hands	Wrists	Elbows	Shoulders
1. I. M.	Calcaneovalgus (bilat.)	Extension contractures (bilat.)	Flexion contractures (bilat.)	Flexion contractures with subluxations (bilat.)	No deformity	Flexion contractures (bilat.)	No deformity
2. J. P.	Clubfoot (bilat.)	No deformity	No deformity	No deformity	No deformity	Extension contractures (bilat.)	Elevated scapula (bilat.)
3. P. O.	Calcaneovalgus (bilat.)	Left: flexion contracture Right: no deformity	Left: flexion contracture Right: no deformity	No deformity	No deformity	No deformity	Limitation of abduction (bilat.)
4. B. M.	Calcaneovalgus with abduction (bilat.)	Flexion contractures with coxa vara (bilat.)	Flexion contractures (bilat.)	Extension contractures of fingers (bilat.)	No deformity	Flexion contractures (bilat.)	No deformity
5. S. D.	Clubfoot (bilat.)	Right: extension contracture Left: flexion contracture	Right: congenital dislocation with adduction contracture Left: abduction contracture	No deformity	No deformity	No deformity	Hypertonicity (bilat.)
6 R. S.	Clubfoot (bilat.)	Extension contracture (bilat.)	Left: congenital dislocation Right: no deformity	Flexion contractures of fingers (bilat.)	Flexion contractures (bilat.)	Extension contractures (bilat.)	Limitation of abduction (bilat.)
7. B. T.	Clubfoot (bilat.)	Valgus and dislocation (bilat.)	Congenital dislocation (bilat.)	No deformity	No deformity	Right: flexion contracture, with subluxation of radial head (bilat.)	No deformity
8. K. F.	Clubfoot (bilat.)	Extension rotation of legs (bilat.)	Congenital dislocation (bilat.)	Club hands (bilat.)	Flexion contractures of wrists	Extension contractures (bilat.)	Limitation of abduction (bilat.)
9. J. P.	Clubfoot (bilat.)	Flexion contracture (bilat.)	Abduction deformity, flexion contractures (bilat.)	Club hands, flexion contractures (bilat.)	Flexion contractures (bilat.)	Right: extension contracture Left: flexion contracture with dislocation	No deformity
10. S. F.	Clubfoot (bilat.)	Flexion contractures (bilat.)	Congital dislocation (bilat.)	No deformity	No deformity	Flexion contractures (bilat.)	No deformity
11. D. G.	Clubfoot (bilat.)	Flexion contractures (bilat.)	Flexion contractures (bilat.)	Claw deformity (bilat.)	Limitation of motion	No deformity	Deltoid paralysis (bilat.)
12. I. K.	Right: calcaneovalgus Left: clubfoot	Flexion contractures (bilat.)	Flexion contractures (bilat.)	Left: flexion deformity of index finger Right: normal	Right: flexion contracture Left: extension contracture	Flexion contractures (bilat.)	No deformity
13. L. P.	Clubfoot (bilat.)	Left: flexion contracture Right: extension contracture	Right: coxa vara with dislocation Left: normal	No deformity	No deformity	No deformity	No deformity

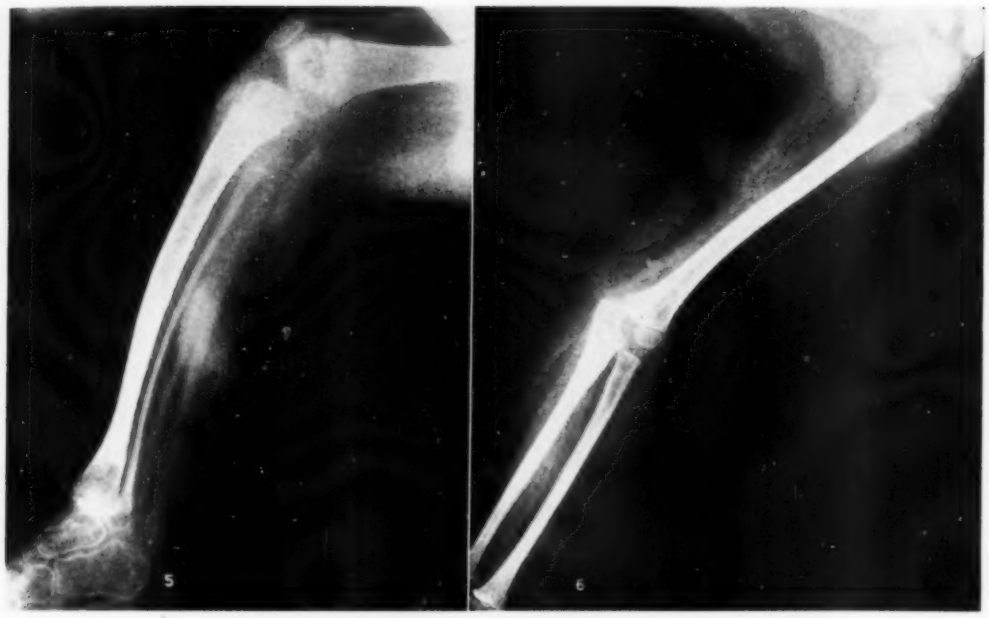

Fig. 5. Lateral view of right leg in Case 8, demonstrating extreme muscle bundle atrophy and osteoporosis.
Fig. 6. Anteroposterior view of left arm in Case 8, illustrating muscle bundle atrophy. Osteoporosis was present but is not well defined. There is an extension contracture of the elbow.

In Table II we have tabulated the orthopedic findings in the extremities, with special reference to the major joints. Flexion and/or extension contractures occurred in varying degrees in all cases, with an average of almost 5 joints per infant involved. The contractures were most common in the knees, with the hips and elbows also frequently affected. These contractures have in common a marked resistance to treatment by the orthopedic surgeon. Even where a good result is initially obtained, there is a high percentage of recurrences in later years.

Clubfoot appears to be a prominent feature of the disease. The presence of a clubfoot deformity or a congenitally dislocated hip in the newborn should bring to mind the possibility of arthrogryposis and initiate a search for contractures.

Figures 1–3 illustrate the appearance of an infant with arthrogryposis. The flexion and extension contractures and the deformities of the feet are well demonstrated.

The roentgen features in arthrogryposis are interesting and in conjunction with the clinical findings are generally diagnostic. Muscle bundle atrophy is uniformly noted, with thin muscle fibers standing out with striking clarity in the soft tissues. These fibers assume a configuration not unlike that manifested by tendons and ligamentous structures and mirror the marked muscular aplasia which is characteristic of this disease. The demonstration of muscle bundle atrophy is best noted in roentgenograms of the lower extremities (legs and thighs).

The bone structures in arthrogryposis generally show porosis, intensified in the lower extremities. In the spine, porosis is usually moderate, while the skull shows little involvement. This would seem to substantiate the idea that the osteoporosis is connected with lack of adequate motion. (Since we have not had the opportunity of checking the roentgenograms of a newborn infant with arthrogryposis, we do not know when the osteoporosis occurs.) The bony texture as seen in the roentgenograms, particularly in an involved limb, is somewhat akin to that in osteogenesis imper-

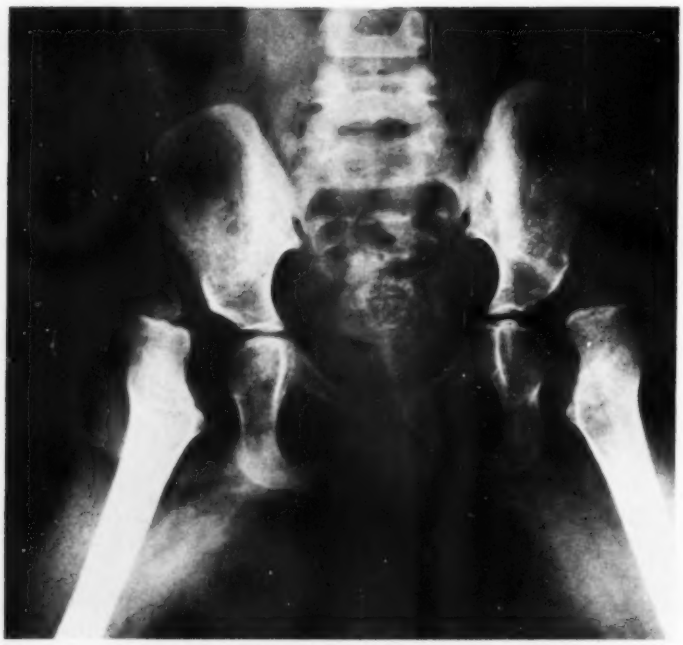

Fig. 7. Anteroposterior view of pelvis in Case 8 only faintly delineating muscle bundle atrophy of upper thighs but clearly showing osteoporosis. Bilateral acetabular dysplasia with hip subluxations are shown.

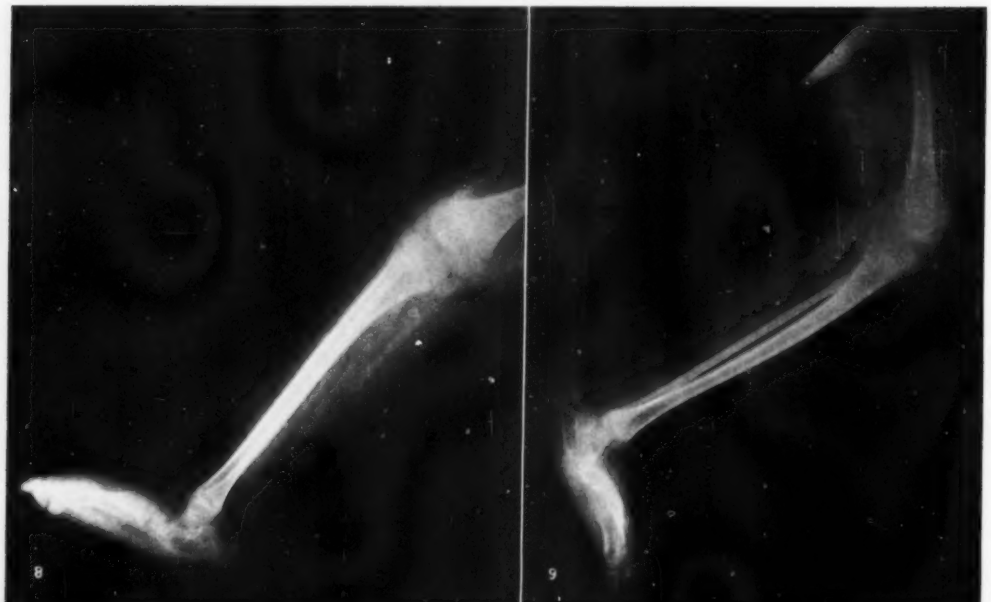

Fig. 8. Lateral roentgenogram of right leg in Case 1, clearly outlining the thin muscle bundles and the osteoporosis. Valgus of the heel seen in this view. An extension contracture of the knee is present.

Fig. 9. Lateral film of the left leg in Case 1 illustrating muscle bundle atrophy, osteoporosis, and valgus of the heel. An extension contracture of the knee is present.

fecta but it is our impression that the cortex is a bit thicker in arthrogryposis.

Although other deformities are easily diagnosed by the astute pediatrician and orthopedic surgeon, the roentgen evidence is helpful in establishing the diagnosis of congenital hip dislocation, clubfoot, coxa vara, spine anomalies, and a host of other conditions listed in Table I.

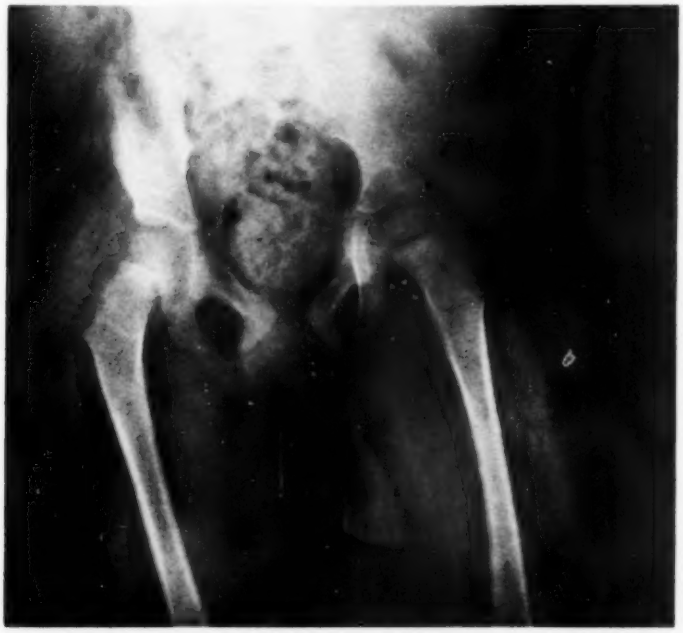

Fig. 10. Anteroposterior roentgenogram of the hips and upper thighs in Case 1, clearly outlining the muscle bundle atrophy and nicely demonstrating the osteoporosis.

Representative examples of roentgenograms selected principally to illustrate the characteristic muscle bundle atrophy, and to a lesser extent the osteoporosis, are reproduced (Figs. 4–13).

For no case in our series do we have complete autopsy findings. In one (Case 11) we have biopsy reports on muscle tissue from the leg and several bone sections. The leg muscle was reported to show hyaline necrosis, atrophy, and fat replacement in some areas. Some of the muscle fibers were said to have well preserved long and cross striations, with the fibers several times smaller than usual. One biopsy bone section showed well preserved compact bone which was called normal, while another biopsy of a tarsal bone on the same patient three years later revealed aplastic bone with retardation of ossification of the cartilaginous portion. The bony trabeculae were seen to be widely spaced in a fatty marrow. Additionally, there were islands of unossified cartilage representing imperfect ossification of the spongy bone.

DISCUSSION

Arthrogryposis is obviously not a common disease. However, the importance of its prompt recognition merits the attention of the radiologist, orthopedic surgeon, and pediatrician. The association of flexion and/or extension contractures with marked muscle bundle atrophy and osteoporosis, more intense in the involved limbs, makes the diagnosis of arthrogryposis a likely one. The radiologist may be of inestimable value in correlating the roentgen and clinical features, thus alerting the clinician to the correct diagnosis.

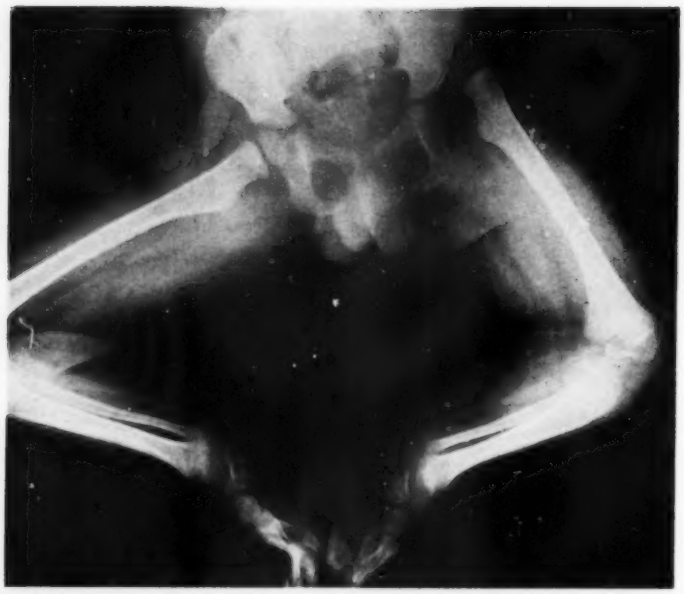

Fig. 11. Film of the pelvis and lower extremities in Case 6, showing muscle bundle atrophy and osteoporosis. Note the left acetabular dysplasia, with dislocation, and the bilateral clubfoot deformities.

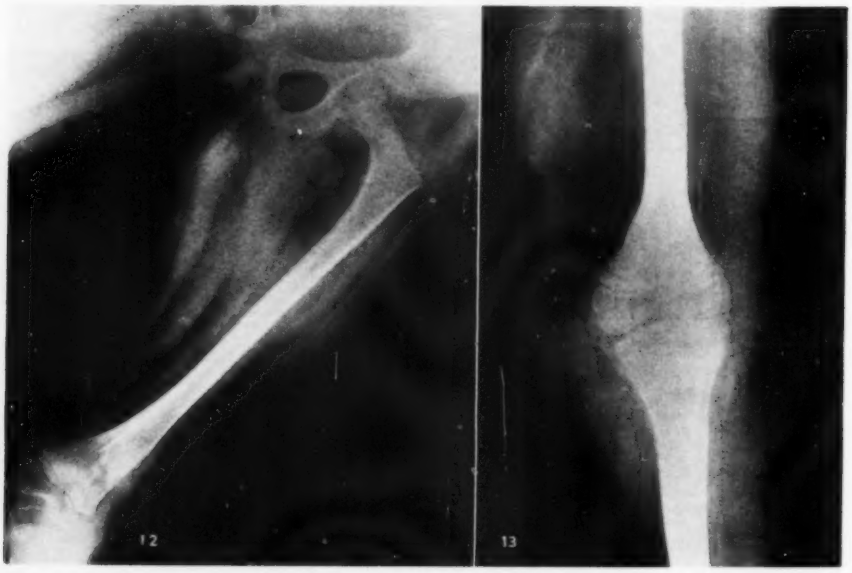

Fig. 12. Anteroposterior roentgenogram of the left thigh area in Case 12, demonstrating characteristic muscle bundle atrophy and osteoporosis. Note the stigma of a flexion contracture of the left knee.

Fig. 13. Anteroposterior view of the right knee area in Case 13, illustrating muscle bundle atrophy. The osteoporosis is not too well shown. An extension contracture of the knee is present.

It is not within the scope of this paper to discuss the differential diagnosis of arthrogryposis in detail. It is frequently confused with amyotonia congenita, but in the latter disease there are no contractures. Other possibly confusing entities such as osteogenesis imperfecta, poliomyelitis, and infantile muscular atrophy generally do not offer too much difficulty.

Although arthrogryposis was described many years ago, it remains little known and understood. The absence of radiological literature on the subject is rather striking. It is hoped that this paper will serve to focus the attention of all those who deal with children on this rather bizarre condition. Particularly is it important that the radiologist be aware of the diagnostic features.

SUMMARY

A brief historical survey of the literature concerning arthrogryposis multiplex congenita is given, and the various theories which have been proposed for its etiology are reviewed.

A series of 13 cases studied personally is reported, with a summary of the clinical and roentgen features. Muscle bundle atrophy, osteoporosis, and flexion and/or extension contractures were present in all. Associated musculoskeletal deformities were of frequent occurrence. Ten patients had clubfoot and 7 congenital hip dislocation.

The importance of recognition of arthrogryposis is stressed, and the role of the radiologist in correlating the clinical and roentgenologic features and alerting the clinician to the diagnosis is emphasized.

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SUMARIO

Artrogriposis Múltiple Congénita

Caracterízase la artrogriposis múltiple congénita por contracturas en flexión y/o extensión de algunas o de muchas articulaciones de los miembros, que existen desde el nacimiento. Características destacadas son la debilidad y la hipotonía musculares. Son frecuentes anomalías concomitantes, tales como sindactilia, polidactilia, pie o mano zambos, displasia de la cavidad cotiloidea, etc.

La causa de la dolencia es desconocida. Es probablemente consecuencia del desarrollo imperfecto o falta de desarrollo de uno o más grupos musculares durante la vida intrauterina. Los estudios histopatológicos han revelado atrofia de las fibras musculares y suplantación de éstas por tejido adiposo y fibroso.

Los AA. han observado una serie de 13 casos, habiendo en todos atrofia de los

haces musculares, osteoporosis y contracturas en flexión y/o extensión. Diez enfermos tenían pie zambo y 7 dislocación congénita de la cadera. Otras deformidades fueron observadas menos frecuentemente. En las contracturas estaban afectadas por término medio cinco articulaciones por lactante, siendo las atacadas más comúnmente las rodillas, las caderas y los codos.

La asociación de las precitadas contracturas con atrofia de los haces musculares y osteoporosis, más intensas en los miembros afectados, deben sugerir el diagnóstico de artrogriposis. El radiólogo puede resultar de valor inestimable para correlacionar las características roentgenológicas y clínicas y poner sobre aviso al clínico en cuanto al diagnóstico acertado.

Las contracturas suelen recurrir, después de corregirlas.

Chest Surveys: A Symposium[1]

Introduction

L. HENRY GARLAND, M.D., Moderator

A REAPPRAISAL of the value of chest surveys, especially in relation to routine hospital admissions, appears to be timely. Mass surveys are now about twenty years old and it seems fitting that they should be evaluated and perhaps set in place. The decreasing morbidity of the tubercle bacillus or the increasing resistance of our population has perhaps caused the yield in mass surveys to fall very greatly. In New York City two years ago it was calculated that only 4 per cent of cases of tuberculosis registered in that city were detected by mass surveys, though large numbers of people have been examined.

It may be, therefore, that general population surveys have served their educational purposes and should be discontinued. Perhaps it is now hospital surveys that are indicated. If so, how should they be conducted, and in hospitals of what size? What may we expect in the form of side-effects or complications?

The Radiologist and Chest Surveys

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Aurora, Ill.

I will limit my remarks to chest surveys as conducted in a small private hospital since this is the area in which the chest survey has not developed as rapidly as had been anticipated. It is estimated that routine chest films are made in only 10 to 15 per cent of all hospitals. Since a mere desire to do the examination and the providing of the necessary equipment do not guarantee 100 per cent efficiency in achievement, actually far less than 10 to 15 per cent of the patients admitted to hospitals are receiving the benefits of this examination.

No radiologist would argue against the public-health value of the routine radiograph of the chest of every hospital patient. There might be discussion of film sizes and whether or not stereoscopy is desirable but the data accumulated make it obvious that the procedure is much more productive in disclosing significant lesions than are several of the other "routine" procedures which have for many years been considered indispensable. Why, then, is the procedure done in so few hospitals? A review of our experience in a hospital of about 200 beds is very revealing, and a recital of it may aid others.

At the Copley Memorial Hospital, Aurora, Ill., we opened a new radiologic department in December 1948. We decided to radiograph the chest of every patient who entered the hospital. Those who had been filmed within the past six months would be exempt. We bought a photofluorographic unit and installed it in one of our combined fluoroscopic-radiographic rooms. After some preliminary shake-down experience, we have operated steadily since Feb. 17, 1949. A review of the chest program was made on Oct. 8, 1951. During the interval, 13,385 persons had been admitted to the hospital. We had obtained survey chest films of only 3,476, or about 25 per cent. Even allowing for admissions during the period of exemption, emergencies, and other possible reasons for not obtaining chest films, the record was rather poor.

Why had we done so poorly? We had

[1] Presented at the Thirty-ninth Annual Meeting of the Radiological Society of North America, Chicago, Ill., Dec. 13–18, 1953.

practically no resistance from the medical staff or patients. There was only an occasional objection to the fee of two dollars per examination. Now and then a patient complained of being got out of bed and taken to the Department of Radiology, but only a few refused to go. Why then, were not more examinations made? Three factors seem to me to be important. The first is the inconvenient location of the equipment, in the Department of Radiology, on the sixth floor of one of the side wings of the hospital. The logical place is in, or adjacent to, the admitting office. With phototimed exposure control, the admitting officer can do the filming. Under these conditions, the patient can be examined without removing his clothes. Patients who cannot be radiographed on admittance can be brought to the admitting office location at a later date, just as easily as they can be taken to any other part of the building. If the radiographic department is convenient to the admitting office, the patient can be taken there prior to going to his assigned room.

The second factor is the location of the photofluorographic equipment in a room used for routine radiography. If the chest survey unit is in a separate room, with either a separate generator or sharing a generator with a unit in an adjacent room, it will be convenient to obtain a chest film immediately upon admittance. If the same room is used for routine radiographic work and for admittance chest filming, difficulty is encountered. Within a few months after opening our department, which we had hoped would be adequate for a long time, it had become so busy that the technicians were apt to defer the routine chest survey cases in favor of more urgent work. We tried to establish certain hours in the mornings and afternoons for the survey examinations. The morning hours were soon dropped and occasionally the afternoon schedule was also omitted. Recently, I began to do gastrointestinal examinations in the afternoon. Now the survey chest examinations are done early in the morning, usually worked in between the automobile accident cases.

The third factor has been the shortage of nurses on the hospital floors. During the period first reviewed, we had been operating with a limited full-time nursing staff, augmented whenever possible by part-time help and nurses' aids. Last year all of the floor nurses were on part time. We have always received a list of admissions and at first, to alleviate the floor nurses' task, we sent our orderlies down to the floors for the newly admitted patients without waiting for a requisition. The orderlies were willing but not too discerning and brought up some patients who were on strict bed rest and even immediate postoperative patients. Since then we have relied, as formerly, upon requisitions from the floor nurse. This procedure fits in best with our method of bookkeeping. The system worked reasonably well for a time following its inauguration. When it began to fail, the radiographic department had become so busy that the defections were ignored. Now most of our cases come from the maternity ward. The average patient there is not ill and word-of-mouth transmission has made the trip to the Department of Radiology, prior to dismissal, a lark and a tradition.

Despite our periodic checks on the workings of the program, our record continues to be poor. A second check, covering the period October 1951 through October 1953, showed that there were 11,436 patients admitted, for only 2,668 (23 per cent) of whom were survey chest films obtained. The Department of Radiology is now so busy that the situation will not be improved until more space becomes available to it.

I should like to tell of our Outpatient Chest Service. Several years ago, we offered to radiograph, on 70-mm. film, for three dollars, the chest of anyone not in the hospital desiring a "complete check-up" or only a "chest check-up." To date we have done only a few such examinations. Perhaps the three-dollar

charge is the deterrent, since free 4 × 5-inch stereoscopic films are available at Springbrook, the local tuberculosis sanitarium. Also, a mobile unit makes routine excursions through the district. Mainly, however, I think the obstacle is the trip to the hospital, undressing, and other inconveniences which cannot be overcome, when no danger is apparent. Whatever the reason, the service has not been utilized. It is of some interest in this respect that, during the first period studied, 2,695 ordinary chest examinations were done on 14 × 17-inch film. This is 77 per cent of the number of survey chest films made. Of this number, over one-half were on outpatients. It seems obvious that a sense of urgency is necessary in the average case to overcome inertia or, perhaps, the desire to "let a sleeping dog lie."

Finally, I would like to say a few words about the cost of the hospital chest x-ray service program. Many figures are available, compiled by various persons and groups. One study, by Russell H. Morgan, appears in the September 1951 issue of the *American Review of Tuberculosis*. Morgan estimated the cost of the examination in a large institution doing 15,000 examinations yearly and in a small hospital of 100 beds doing 2,000 examinations yearly. He concluded that the cost of the examination in the large hospital was seventy cents and in the small one about a dollar. He also estimated the professional fee of the radiologist in the small hospital at fifty cents per film. Mr. Orville Peterson, the Administrator of Copley Memorial Hospital, examined Morgan's estimates of the cost in the small hospital and believed they should be increased 50 per cent. Incidentally, Morgan in his reprints adjusted the figures upward from the original data, to bring them in line with rising costs. It would seem, therefore, that our charge of two dollars per film was average in 1951 and now is below actual cost.

Some comment should be made as to the compensation of the radiologist. Morgan thought that some of the lag in the development of the survey program in the 50- to 200-bed hospital was due to the reluctance of the radiologist to undertake a non-profit venture, based on the free chest-survey programs in vogue in many large teaching hospitals and advocated by some health authorities for all hospitals. Currently, radiologists are servicing large public surveys on either a time or piecework basis. The usual compensation seems to be between ten and fifteen dollars per hour or ten to fifteen cents per film. No arrangement can encompass all conditions. A radiologist can read a relatively large number of films per hour if the patients have been disrobed, the technic is satisfactory, and the films represent an initial examination. When shadows due to clothing and technical artefacts have to be considered and particularly when several previous films have to be reviewed, progress is slow. Ideally it should not, but actually it does, make a difference whether one is reading the films of a group of strange people who are part of a large survey or whether the films are of patients in one's private practice. Thus, a survey film of a patient for whom one has just done an examination of the gastrointestinal or urinary tract would naturally be studied more carefully than the film that is part of a street corner survey. An error on the latter film would not influence one's practice directly, whereas an error on a private patient would bring immediate repercussions.

Since all careful studies have shown that the percentage of error in diagnosis is higher on the small survey film than on the regular 14 × 17-inch film, and since those studies probably were made with greater than average care, it seems reasonable to assume that readings made in the course of a busy day would show more errors than the published material. From the above, it seems logical to conclude that the radiologist reading survey chest films in his private practice must either devote considerable time to a careful consideration of the small survey films or be faced with an increased percentage of

error in their diagnosis, as compared to large films. I believe, therefore, that Dr. Morgan's approximation of fifty cents apiece for reading survey films in a private practice is not only reasonable but less than the service is worth. I say this because I believe that every time one reads a small survey film, one is risking his reputation on the basis of "less than the best available" evidence, which means the 14 × 17-inch film. In case of an error, neither the patient nor the attending physician is apt to remember that the examination was a cheap survey one. I always have and probably always will shy away from using the small films for a definitive diagnosis. Every day I feel more in sympathy with those radiologists who either discard the survey film immediately after interpretation or file it in a place available only to themselves, in order to prevent its use for definitive diagnostic purposes.

In conclusion, my experience is in line with general experience expressed in the literature, that it is desirable to radiograph the chest of every person admitted to a hospital. The filming unit should be in or near the admitting office, and a film should be made immediately upon admittance. If in the Department of Radiology, the filming unit should be in a separate room. The survey film should not be used for definitive diagnosis or for the recording of the progress of a lesion.

The Hospital Administrator Looks at Chest Surveys

RAY E. BROWN

Chicago, Ill.

I must confess that I cannot understand, if everybody is so much in favor of routine chest microfilming of all hospital admissions, why it isn't done more frequently. As Dr. Wachowski said, less than 15 per cent—and I would say less than 10 per cent—of our general hospitals are not doing it. I should like to have a show of hands (for purely statistical purposes) of those who are radiologists in hospitals that do have compulsory routine admission chest microfilming or filming. [About 25 per cent of those present held up their hands.] I think the figure here would be higher than 10 per cent, but it is clear that it is still low.

I have been trying to think of some of the reasons for failure to carry out admission surveys, and if I make the hospital administrator an unusual party in this, I hope you will appreciate the fact that I am one hospital administrator among a large number of radiologists. Actually I do not think it is the fault either of the Board of Trustees or the hospital administrator that we do not have compulsory, or at least routine, chest filming of every patient admitted. In reality, a good hospital administrator should not make the medical decisions for the hospital. It is up to the medical staff and to those with a special interest—in this case the radiologist, since it falls within his department—to demand from the administrator and the Board the funds to accomplish those things that they think are justified. By justified, I simply mean in terms of the cost of the trouble to the patient. Is that equaled by the results obtained?

Every time I appear on, or listen to, a program in which this topic is discussed, I am again convinced that, even if the cost of the microfilm is three dollars rather than two dollars, it certainly yields far more results than many of the other diagnostic tests for which the patient is charged an even larger sum. I am quite sure that, in the three hospitals of which I have been administrator, many of the tests for which we charged five or sometimes ten dollars did not yield a percentage of results so startling or dramatic as the percentages that we find reported for chest surveys in the medical and hospital literature.

There are several reasons why we should have such a program. I think the radiol-

ogist must educate hospital administrators and medical staffs by seeing that they appreciate the great advantages to the patient of the installation of a routine film service for all admissions.

Let us look at the matter of cost—two dollars or perhaps as much as three dollars. Who should pay it? I feel very strongly that the patient should pay. The examination is done in his behalf. Many hospitals, including my own, now charge a first-day routine laboratory fee. In our own institution this is ten dollars. If necessary, the hospital could add two or three dollars to this routine laboratory charge, and if all hospitals did so, no one hospital, or one department of radiology, would be unduly blamed over another.

I am afraid much of our problem lies in the fact that, of the total of some five thousand general hospitals in this country, not less than two-thirds have fewer than one hundred beds. Doubtless in many of the small institutions they are not familiar with Dr. Morgan's article in which he points out that even the smallest hospital, by the purchase of a photofluorographic hood and a camera, can do a chest microfilm for two or three dollars, depending on how much is allowed to the radiologist. The many small hospitals which do not have a full-time radiologist could incorporate in their contract with the radiologist who comes in perhaps one day a week, or to whom films may be sent for interpretation, a provision for the reading of the chest microfilms.

The biggest remaining question would be the matter of inertia or indifference on the part of the medical staff. As a hospital administrator, I want to tell you that hospital administrators in general do whatever the medical staff, as a majority, wishes done. If we are missing a test that in terms of cost can be wholly justified in any hospital, then I say it is because the radiologists and the hospital administrators have not convinced the medical staffs of the benefits that come from such a program.

Finally, I also hold responsible for our inertia, or our indifference, the third parties who are involved in the payment for hospital care. Blue Cross and other prepayment plans do not allow hospitals to include a charge for the chest microfilm because they consider it diagnostic. Those hospitals that do not charge extra for the admission chest film are, of course, allowed to include it in the cost which they compute for Blue Cross. I can sympathize very much with the idea that the smaller hospital cannot afford to include this without a fee for the radiologist and without recovering the direct cost and amortization of the equipment. As long as Blue Cross and other third parties insist that they will not consider the admission chest film the same as the routine blood or urine examination, we are going to be hard pressed to secure the support of Board members and of administrators in putting in such an examination.

There are other groups. Local public health departments have spent millions of dollars throughout the country with their mobile trucks doing mass chest microfilming. Our tuberculosis seal funds throughout the country have similar programs. Well, I ask you, how much have local public health departments or tuberculosis seal funds, or other private health agencies, been willing to underwrite the cost of such equipment as is necessary in their local hospitals. Once the hospital has the equipment, and once the doctors are used to having the service, the chances are that the hospital will pick it up and carry it as part of its budget. I do have one suspicion as to why such agencies are not more interested. Driving a mobile unit all over the city with the agency's name emblazoned on it for fund-raising purposes is better advertising than a service hidden in the department of radiology or even adjacent to the hospital admitting office.

I will conclude by saying that I am frustrated every time I discuss with a group, or with an individual, this question of routine chest programs for hospital admissions. The only answer seems to be that the problem is lost between the several groups making up the hospital family. If

we could convince the medical staffs, and if we could convince some of the radiologists who have not given too much support to the idea, then I think we could provide more widely an essential service to the hospital patient.

Routine Chest Films of Hospital Admissions from the Standpoint of the Specialist in Diseases of the Chest

EDWIN R. LEVINE, M.D.

Chicago, Ill.

From the standpoint of the specialist in diseases of the chest, a routine chest x-ray examination is a very necessary procedure. This applies equally to the general population and to patients admitted to hospitals. The emphasis on the hospital patient is explained by the fact that here is a fruitful field for the discovery of unsuspected disease, and it is unsuspected disease that is most important.

In the beginning, the great problem was thought to be the discovery of early or asymptomatic tuberculosis, and the routine chest examination of hospital admissions was regarded as a very fine method of protecting the patients and hospital staff from the hazards of infection. It is perfectly obvious that, until tuberculosis is relegated to the limbo of forgotten diseases, and takes its place with bubonic plague, smallpox, and typhoid fever, the value of the chest film in protecting patients and staff from unknown active tuberculosis will still remain. But the importance of finding tuberculosis goes far beyond the protection of hospital workers. With advances in treatment, with the development of adequate antimicrobial therapy, and with the possibility of surgery where surgery is indicated, the discovery of early tuberculosis represents the hope of elimination of this disease.

Early tuberculosis is not communicable. Tuberculosis becomes communicable only when cavities are present and are associated with cough and expectoration. When these factors are absent, there is no danger. Furthermore, it is axiomatic that tuberculosis is asymptomatic almost up to the time when it can be regarded as far-advanced, with the exception, of course, of the fortunate patients who have pulmonary hemorrhages which lead to x-ray studies.

A great many questions in addition to that of tuberculosis are raised in a consideration of routine x-ray surveys—questions of other types of disease. For to the chest specialist, the accidental finding of a chest lesion represents, in almost every case, the only way of picking up these diseases early, frequently at the only treatable time. Much has been said about the early diagnosis of bronchogenic carcinoma, a diagnosis possible only by x-rays. The isolated nodular area, the so-called "coin shadow," is well known and has been spoken of much. There are other shadows also that may represent early bronchogenic carcinoma. There is the localized area of lung distention, sometimes called emphysema, a dilatation of a segment of the lung due to partial obstruction. There is the increased shadowing in the lower portion of the paramediastinal field, obviously most visible on the right. And there is the realization that apical and subapical shadows do not necessarily indicate tuberculosis but that early bronchogenic carcinoma may show this particular configuration.

The presence of other tumors has not been sufficiently stressed. The obvious mediastinal mass is frequently mentioned, but not enough emphasis has been placed upon irregularity of the mediastinal outline which may not have reached the stage of actual enlargement but yet may represent a tumor not clearly demonstrated in the postero-anterior view. Metastatic lesions, from the standpoint of treatment or prevention, are of only academic interest.

We feel that the question of emphysema and pulmonary fibrosis should attract a great deal more attention than it does now. Since this disease has come into the category of conditions for which treatment is available, the earlier it is suspected the better will be the results. It is true that the ordinary postero-anterior film will not be diagnostic except in the most advanced cases, but when the lung fields show suggestive areas of fibrosis or even a suspicion of emphysema, it should be reported so that an adequate clinical and x-ray work-up can be undertaken to determine whether or not this disease is present.

Another field that requires much more investigation is that of heart shadows. In general, in the reading of the routine survey film, the heart is not mentioned unless it is obviously abnormal, and yet it is common knowledge that a heart that shows slight changes in the left border or in the position of the aortic knob may, on adequate study in left and right oblique positions, be shown to have abnormally large chambers. Such studies are best made in hospitals and not in mass x-ray surveys of the general population. It is indeed worth while to develop a technic of determining when a heart can be considered abnormal roentgenologically or, to put it another way, when the clinician should be alerted to the fact that there is some departure from normal. In such a study lies hope of preventing some of the cardiac difficulties which now can be treated only by supportive medicine.

On a review of these observations, it becomes obvious that there are suspicions as well as diagnoses. In fact, diagnoses from the routine chest examination of hospital admissions are few. The specialist in chest diseases hopes that the roentgenologist will give great guidance to the clinician. We hope that he will look at these films with a suspicious eye and that he will not only report deviations from the normal, but will make recommendations as to what sort of a work-up is indicated by the findings. When a chest physician is called into consultation following discovery of an abnormal shadow on a regular postero-anterior film, one of the first things that he does is to look at the film and suggest that it might be a good idea to make such-and-such x-ray or fluoroscopic studies and to carry out certain clinical and laboratory procedures.

The value of such studies as have been suggested can hardly be overestimated. It is true that irregular mediastinal shadows, for instance, may in a large percentage of cases turn out to be anomalies of blood vessels, but the finding of an early lymphoma will justify many unnecessary examinations of normal patients. The determination that the pulmonary arteries are rather larger than would be anticipated may lead a clinician to discover changes in the lung parenchyma which, if left untreated, would result in right heart strain and cor pulmonale, producing the first symptoms of which the patient may complain. The recommendations that might be made on isolated nodular shadows or areas of infiltration, at least from the standpoint of a roentgenologist, should include all the work that is essential to determine whether or not these lesions justify surgical intervention and exploration, whether they should be treated medically or should simply be left alone. If this is practiced, there will be no hospital procedure that will begin to have the diagnostic and preventive value of the routine chest survey. The clinician will be told of the suspicious shadow and what it may appear to be and with such guidance will make sure that the work-up on the patient is adequate. From the point of view of the chest specialist, this brings diseases of the chest to the spot in medicine where they belong, where the average internist and good general practitioner can work them up from a diagnostic standpoint and establish adequate therapy in almost every instance.

What the Public Thinks of Chest Surveys

ROBIN BUERKI, M.D.
Detroit, Mich.

It is comforting for once to be cast in the role of John Q. Public, an atom in that amorphous mass normally known as the public, because if I wander afield in my remarks or if I am unscientific in any statements I make, I can shrug my shoulders and say, "I am only a layman."

As John Public some years ago, I listened to Dr. Ryerson of Toronto, who said, "Here is perfect health and here is death; here is where we live thinking we are well and thinking that we will continue to be well; here is where the doctor comes in between that moment when we decide we are sick and death, and here is what we ought to do—seek medical advice while we are well so that we may improve our feeling of well being." As a layman, I was impressed tremendously. I went back to my family doctor (and I do have a family doctor whom I trust next to God), and my family doctor, an unusually intelligent man, said, "Dr. Ryerson is talking about positive health. He is talking about the medical profession doing something before you have pains or think you are sick. He is talking about keeping you well. He is asking that the profession recognize abnormal physiology."

I said, "Well, Doctor, I have had several physical examinations but I don't know that I have ever really had a thorough and complete examination of the type described by Dr. Ryerson."

He immediately admitted to me that even professors of medicine get excited about the spleen that is ten times its normal size and fail to be interested in the man they diagnose as normal. My family doctor told me that we must develop whole new yard-sticks of measurement and then he pointed to the routine photofluorogram of the chest as an example and asked me, admitting that only 3 or 4 per cent of the films taken will show anything, whether I would be willing to pay for such a film. And I hastened to say, "Of course I am willing to do that."

It is all right to say that the cost is too high because only 3 or 4 per cent will show any abnormality. But for myself and my family I want to take that gamble. I gamble every day on everything from lottery tickets to crossing streets in heavy traffic and I am willing to gamble a few dollars on health.

I do like the idea that you have this yardstick of measurement that can tell me if there is something wrong in my chest. I ask you, then, can you go on and do the gastrointestinal tract on this same routine basis. Can the biochemists in their field develop tests that will warn me to take care of myself while I am still feeling well. When I have swelling of the feet and puff like a porpoise after three holes of golf, I know I am sick and little can be done for me when I reach that stage. All you can do then is to tell me what is wrong with me. At best you may make me feel a little better, but I know that I am going to be a burden to myself and my family for the rest of my life. Had an earlier diagnosis been made, this condition might have been prevented.

To you as radiologists, my plea is to go further and see that all hospitals make routine chest surveys a part of a health program. I think you have already done much in the field of positive health by the use of photofluorograms.

General Discussion

Robert R. Newell, M.D. (San Francisco): The discovery of unsuspected pulmonary carcinoma at a time when a person has the chance to be cured by pneumonectomy might well be considered priceless. The discovery of pulmonary tuberculosis before it becomes symptomatic

might easily save the patient thousands of dollars in doctors' and sanitarium costs, and as much more in lost income. But I am not going to make illogical use of anecdotes of the discovery of *incurable* disease.

In San Francisco we have for five years conducted an almost unique experiment at the Medical Society with surveys of patients whom our members have sent in. Their instructions are to send no one who has had a recent chest film or for whom chest radiology is contemplated. They are supposed to send those in whom they suspect no need: in other words, this is designed to be purely a survey.

This differs from the general survey in two ways: it differs from the hospital survey in that the patients chosen are those who would not ordinarily get a chest examination, which isn't true of routine hospital entries. It differs from the general population survey because the patient has a physician and is followed. It costs about fifty cents to take one film and report by mail to the doctor who sends the patient. This is equivalent to about three minutes of the doctor's time. A doctor considers that a patient who warrants an examination at all warrants auscultation and percussion of the chest. Can that be done in three minutes?

Chest radiology is looked upon by us radiologists, I'm sure, as bread-and-butter business. There are many jobs that take so much of our time and attention and are so burdensome that we are really ill paid for the work. Chest radiology ordinarily is fairly well paid for, per minute of time.

Radiologists think that the surveys should come to them. The survey business is not consultative medicine. The radiologist gets a consultative fee for it but does not give the time nor mobilize the resources and make the correlations that are a part of such practice. Chest radiology is done in order to help a doctor discover the reason for his patient's difficulties.

If we should use surveys for all they are worth, we would move quickly, there would be telephone conversations between the surveying radiologist and the patient's doctor, and the survey business would immediately begin to be loaded with consultative service. As soon as that happens, the cost in the doctor's and radiologist's time jumps—it could easily be to three dollars and a half or five dollars. I think minifilms ought to be used for all they are worth, and that therefore you should find that the costs do not stay at fifty cents.

There is a chance of error on the survey film, about which I will say more in a minute. The patient will say that he was unhappy since his disease was missed because he got a cheap survey film. I maintain that minifilms ought to be looked upon as radiology. For many things they are just as good as 14 × 17-inch films. It is the attitude that one takes toward them that determines whether they are only of survey value or of consultative value, but if they are used for all they are worth, then they should not be looked upon as "cheap survey films," whether the price is fifty cents or five dollars. This should not be made a *cheap* service.

If you have a service which you consider good, I think it is disadvantageous to charge a cheap rate. Therefore, I think that survey minifilms should be loaded with all the consultative medicine that can be used and that they should either be charged for at their full worth or not be charged for at all. I think it is a great mistake to say: "This little film costs you only a dollar or a dollar and a half, but if you want a big film it will cost you five or ten or fifteen dollars." I think if the big film is worth fifteen dollars, the little film is worth fifteen dollars, too. Size has nothing to do with it: it is entirely a matter of what service is being given by the doctor whose diagnostic tool it is. So I say it is a mistake to call these "cheap survey films." If you are going to use them merely as a survey, well and good, use them as a survey. That is a restricted service, but don't call it cheap. If you can't get a proper fee for it, do it for nothing.

[Dr. Newell then presented slides to show the follow-up by the San Francisco Health Department (89 per cent success for the Medical Society cases) and statistics from the Medical Society Minifilm Chest service (50 cases a year brought to bed with tuberculosis out of some 15,000 a year surveyed). He also cited cases showing that lesions readily missed on 14 × 17-inch film as well as on minifilm are often important.]

L. Henry Garland, M.D. (San Francisco): The problem at issue is: Will routine admission chest surveys be of use in the average hospital? Let us for a moment look at the yield of previously unknown disease picked up by x-ray surveys, and let us see what is happening to tuberculosis in this country.

This slide (Fig. 1) shows what has happened in

Fig. 1. Decline in death rate from tuberculosis in the United States during the last fifty years. There has been no marked drop since 1935. The heavy broken line indicates the x-ray survey era.

TABLE I: CHEST SURVEYS AND FINDINGS

Disease and Series Examined	Cases Found	Reference
Tuberculosis		
Several million adults U.S.A., 1940–50	Active new and previously known cases (sputum verified): range from *100 to 50 per 100,000*	Garland: Am. J. Roentgenol. **64:** 32–41, July 1950.
153,510 adults Worcester, Mass., 1952	Active new cases: 55, or *36 per 100,000*	Scarcello: J.A.M.A. July 4, 1953.
223,004 adults Zurich, 1950	Active new and old cases: 104, or *47 per 100,000*	Schinz: Am. J. Roentgenol. **67:** 136, January 1952.
Carcinoma		
1,867,201 adults Los Angeles, 1950	Primary bronchogenic carcinomas (verified): 144, or *8 per 100,000*	Guiss: Cancer **5:** 1035-1040, September 1952.
536,012 adults Boston, Mass., 1950	Verified cases: 43, or *8 per 100,000*	Scamman: New England J. Med. **244:** 541–544, April 12, 1951.
Heart Disease		
155,021 adults San Francisco, 1950	Previously unknown cases: 89, or about *57 per 100,000*	Selzer: Am. Heart J. **42:** 355–361, September 1951.

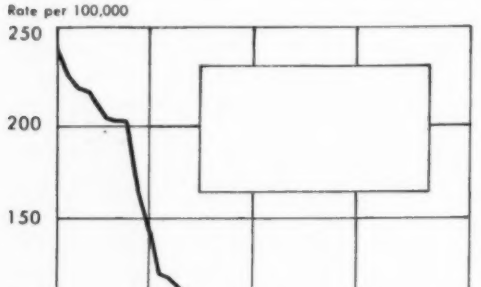


Fig. 2. Age-adjusted death rate from tuberculosis, published by the Metropolitan Life Insurance Company, covering, in the main, adult white policy holders.

tuberculosis in the United States between 1900 and 1950. This chart was kindly sent me by Dr. Carroll Palmer of the Tuberculosis Control Division of the U. S. Public Health Service. It is seen that there has been no change in the steadily declining curve since 1933, when mass surveys started.

Let us now examine the age-adjusted death rate curve (Fig. 2) of the Metropolitan Life Insurance Company. Between 1933 and the present date there has been no change in the slope of the curve. Mass x-ray surveys have produced no demonstrable effect in the decline of tuberculosis mortality. It is to be noted, also, that the decline in the death rate of tuberculosis is essentially as great in states and counties without mass survey facilities as in those with them.

Now what is the yield of previously undetected tuberculosis in mass surveys? In Table I the specific references are on the right-hand side, the details in the middle, and the number of cases examined on the left. In 100,000 adults that you x-ray today, you will pick up about 50 *new* cases of active pulmonary tuberculosis. You will also detect about 8 unsuspected primary bronchogenic cancers and 57 cases of heart disease. Enlarged or arteriosclerotic hearts, for which little can be done, make up a large proportion of the latter group. It seems to me that we should bear in mind the low potential yield in most routine admission survey programs.

George Jacobson, M.D. (Los Angeles, Calif.): There are several things I would like to agree with and several with which I would like to disagree. I would like to point out that until recently the emphasis in tuberculosis case-finding has been on the mass survey. While mass surveys have been of great benefit, their primary value has been in educating the medical and the non-medical professions as to the continued high incidence of tuberculosis in the general population and the need for the development of a continuous, efficient case-finding method.

Many communities maintain mobile photofluorographic units such as you see in the streets. I personally think that they are uneconomical. Following a survey, a great number of people will visit these units, but soon fewer and fewer do so. The people who should come to these units do not; that is, those in the older age groups and those who may suspect that something is wrong with them.

As to the incidence of tuberculosis in hospitals—and I can only talk about a large hospital such as ours—I should like to quote just a few figures. Dr. Garland questioned some of our results. In 1950 Bryant published a paper summarizing all of

the hospital surveys which had been reported to date, and most of them were in hospitals of under 200 beds. These figures showed that tuberculosis was present in 26 to 81 per thousand hospital admissions. A recent study in New York conducted by Dr. Hilleboe reported 11 cases per thousand with one-fourth of these cases active.

These figures should be compared to the results of the mass survey. The United States Public Health Service has just published the results of their seventeen community-wide surveys. They found that there were 9 cases of tuberculosis per thousand population, with one active case per thousand. And, incidentally, of these cases of tuberculosis, 75 per cent were previously unknown. Compare this to the results which we have had at our hospital.

We have made a final diagnosis of tuberculosis in 21 patients per thousand admissions, that is, per thousand individual admissions; if we estimate those that we could not follow at the hospital but referred to the various Public Health agencies, there are 31 per thousand.

We proved a final diagnosis of active tuberculosis in 10 per thousand individuals admitted, and 60 per cent of these cases were previously unknown. In view of this we have come to certain conclusions:

(1) The mass survey, while it has served a purpose, is an uneconomical tuberculosis case-finding method and it is doubtful that future community-wide surveys should be conducted.

(2) The admission chest x-ray program, particularly in large general hospitals, is the most efficient tuberculosis case-finding method which is available today.

One other feature of this is the prevention of tuberculosis among hospital personnel. Prior to 1951 we averaged approximately 15 cases of tuberculosis among our interns, residents, and nurses. Since 1951 we haven't had a single case. This is only a two-year period but I think it is very significant.

The cost per examination, as closely as we can estimate it—and this is cost accounting our equipment, a charge for space, janitorial service, etc.—has been seventy-six cents per film.

Mr. Brown suggested that one of the reasons there are not more admission chest x-ray programs is that the Tuberculosis Associations do not support them. I think that he will find that it is the avowed policy of the various societies to support as many of these programs as possible. The Tuberculosis Association has given us over $100,000 for our program.

Dr. Garland: Before you go, Dr. Jacobson, tell the group the percentage of people in your hospital who are Mexican and colored.

Dr. Jacobson: I'd say it runs, roughly, 60 per cent. One must take that into account but I think that the figures which have been reported from smaller hospitals, including Dr. Hodges' report from the University of Michigan, showed a greater incidence than in our hospital.

W. Edward Chamberlain, M.D. (Philadelphia, Pa.): I certainly enjoyed Dr. Jacobson's discussion. All my experience tells me that he's got the real goods. A lot of things that Dr. Garland said are right, too, but his figures are misleading. We don't have many Mexicans, and New York takes all the Puerto Ricans, but we do have a lot of people in Philadelphia and our figures are five times as large as Dr. Garland's. A few years ago we started doing surveys of special groups such as food handlers, and the first year we picked up 114 active, positive-sputum cases.

We did some surveys at Uncle Sam's and your expense but I think it was worth while. We worked very hard for six years. At the end of six years we went back through all the cases followed for that time and we found there were 100 cases of active tuberculosis disclosed by the six-year study; the first year of study showed only 20. Now some cases may have developed in the meantime. In all, shadows were present to start with. But the point is that the methods used ordinarily are not good enough to reveal all the active cases; so some of those cases that Dr. Garland notices merely as shadows, with no sign of active tuberculosis and with negative sputum, are really important cases of tuberculosis.

Dr. Buerki suggests that we develop a lot of new tests. I say, let's learn to use the tests that we already have before we develop any new ones. We are not making proper use of these x-ray surveys. This community-wide survey business is ridiculous. If we are not going to be able to do it for everybody, or if we are not going to x-ray all the people every year, then let's go where we can get results. We have the answer to that in our hospital admissions survey, but we are not doing an efficient job. With our survey methods it works out like this: A woman comes in, in labor, at 5 A.M. She isn't x-rayed. As she leaves the hospital with her new baby, she gets an examination and it shows tuberculosis with cavities. Her obstetrician is told about it. He tells her husband and advises the woman: "Go to the chest specialist. Hurry up and take care of this." Nine months later we find that woman dying of tuberculosis and learn that nothing was done about it. Her excuse is, "Well, I was too busy taking care of my baby."

Hospitals can afford to make these films for nothing, because in any hospital where there are private patients and where the radiologist and the hospital are making out all right, as they are in many hospitals, you will find that the survey film picks up a lot of business for the Department of Radiology.

Leo Rigler, M.D. (Minneapolis, Minn.): I want to endorse what Dr. Jacobson said, particu-

larly with regard to the matter of protection of hospital personnel and hospital patients. I am astounded to hear a hospital administrator, unintentionally I am sure, pass the buck as it were, to the medical staff and act as if administrators had no responsibility in this matter. Every hospital feels the responsibility for the protection of its personnel and actually this hospital admission program was originally advocated for that reason alone; I think if that were the only reason, aside from any collateral benefit to the community, it ought to be undertaken.

I think there is far too great emphasis on the number of square inches of film. For a small hospital of a hundred beds to purchase photofluorographic equipment is a mistake; it is simpler for such hospitals to do the job with the usual technic in the x-ray department, and they will get much more done.

I am also astounded at Dr. Wachowski's statement that they are able to obtain survey films in only 25 per cent of admissions. We now achieve about 96 per cent because we don't rely on photofluorograms alone. We do photofluorograms, we do bedside films when we can, and we do ordinary 14 × 17-inch films with the usual technic when it proves to be easier for sick patients. As a result, we feel that we are affording the largest possible protection to our hospital personnel and the other patients against tuberculosis.

I believe we are really making progress. In the Twin Cities, for example, every hospital with the exception of two has this program in operation, and those two will soon have a program under way. I mention that to show what can be done. In Minnesota, almost 50 per cent of the hospitals over the whole state have such a service or are about to begin one. All of this even though the tuberculosis death rate in Minnesota in 1952 was slightly over 6 per 100,000, a good deal lower than in California, despite the sunshine, or maybe because of it. I emphasize this because we feel in Minnesota that 6 per 100,000 is 6 too many, and if there is anything at all that we can do to eliminate those 6, we ought to do it even if it does cost a little money.

Mr. Brown: Just one word. I want to assure Dr. Rigler that we are very much interested in this program. It is a great safety device, and any hospital that wishes, especially if it has a school of nursing, could almost chalk up the total expense to the hospital on that basis. So, as a hospital administrator, I would like to say I am doubly earnest in stating that you must get the medical staff to convince our Boards that a program of this type is necessary.

Dr. Garland: We're all in favor of tuberculosis eradication. We're all in favor of x-raying the nurses and staff. The problem we are discussing is, should we consume the energy and time of busy radiologists in x-raying a hundred thousand hospital admissions for such a small yield? Dr. Buerki, would you care to have a final word?

Dr. Buerki: Seriously, for the last few months I have been asking a lot of individuals whom I thought were intelligent what they wanted in this program, and I have been amazed at the number that did want yardsticks of measurement from the medical profession. They wanted to rely on the profession.

As a hospital administrator and as a doctor, I believe in routine photofluorograms of patients, not to supplant but to supplement. I am of the school that feels we should do more checking, both x-ray and laboratory, rather than less, and that the public can be and will be happy to pay for it.

Dr. Newell: Dr. Garland pointed out one very important statistic—that the expected incidence of active tuberculosis in the general population is 50 per 100,000. In the San Francisco Medical Society's survey it was 50 in ten thousand the first year.[2] I have follow-up return postals on the majority of these, checked in the column "previously unknown."

[2] Moderator's note: This 50 included old or previously known as well as new cases. Further, the diagnoses were, as a rule, clinical or radiological and not bacteriologically validated.

SUMARIO

Encuestas Colectivas del Tórax: Certamen

El problema de las encuestas colectivas del tórax aparece discutido desde el punto de vista del radiólogo, del administrador de hospitales, del tisiólogo y del público general. En general, sostiénese que esas encuestas poseen limitada utilidad y que el método preferido consiste en el examen sistemático de todas las personas recibidas en los hospitales. Estos exámenes conducirán al descubrimiento no sólo de más casos de tuberculosis activa sino también de neoplasias broncógenas y de cardiopatías insospechadas. Entre los puntos discutidos, figuraron los de si el examen debe ser o no obligatorio, cuál debe ser el costo y si éste debe ser sobrellevado por el enfermo o por el hospital. Expresáronse opiniones muy variadas.

Radiologic Aspects of Operable Heart Disease

I. Observations on the Preoperative Approach to Congenital Anomalies[1]

HERBERT L. ABRAMS, M.D.

REFINEMENTS IN medical diagnosis are a basic prerequisite for advances in therapy. Just as the entire field of antibiotic therapy rests solidly upon the enormous accumulation of knowledge and increased precision in bacteriology, so the ever increasing application of surgery to heart disease, and particularly to congenital cardiac anomalies, is dependent on increasing familiarity with and more exact recognition of operable cardiac lesions. Nowhere in the cluster of specialties that deal with cardiac anomalies has progress in diagnosis been more dramatic than in the field of radiology.

Bing has stated that "roentgenographic examination constitutes the most important part of the clinical examination in congenital heart disease" (8). This evaluation, not by a radiologist but by one who has made important additions to our knowledge of the physiology of heart disease, constitutes a reasonable acknowledgment of the potential importance of the radiologist's contribution. The extent to which this potential is realized depends on the radiologist's ability to integrate his interpretation of a roentgenographic image, or series of images, with the clinical and laboratory data in a given case. This, in turn, is dependent on his knowledge of the basic anatomic, clinical, and physiologic aspects of cardiac disease.

There has been in the past an unfortunate tendency among some radiologists to forego the specific diagnosis and to rely upon the generalization in congenital heart disease. By way of justification, it is stated that the lesion could be congenital, metabolic, degenerative, rheumatic, syphilitic, or anemic, and that the anatomic diagnosis can be made with certainty only by the pathologist. This approach represents an abdication of clinical responsibility by the radiologist. Certainly there are many instances in which the diagnosis is not clear-cut; there are many more, however, in which the proper diagnosis can be suggested with a fair degree of assurance. The day is past when the type of cardiac anomaly is a matter of indifference or of academic interest. Both life-saving and palliative operations have been devised whose proper application depends entirely on precision in diagnosis, and whose misapplication may be fatal.

Cursory examination of the lengthening list of cardiac lesions amenable to surgery (Table I) suggests the magnitude of the responsibility of the diagnostic team. In the final analysis, the radiologic data may be the single most important factor in determining whether a case is suitable for operation. In Table II are indicated sche-

TABLE I: CARDIAC ANOMALIES AMENABLE TO SURGERY

Acyanotic		
1.	Patent ductus arteriosus	Gross (1938)
2.	Coarctation of the aorta	Crafoord (1944), Gross (1945)
3.	Pulmonic stenosis	Brock (1948)
4.	Atrial septal defect	Murray (1948), Swan (1953), Gross (1953)
5.	Ventricular septal defect	Murray (1948), Bailey (1951), Kay (1954)
6.	Aortic septal defect	Gross (1952)
Cyanotic		
1.	Tetralogy of Fallot	Blalock (1945)
2.	Tricuspid atresia	Blalock, Potts (1948)
3.	Pulmonic stenosis with patent foramen ovale	Brock (1948)
4.	Transposition of the great vessels	(?) Hanlon and Blalock (1949), Lillehei (1953)
5.	Total anomalous pulmonary venous return	Muller (1951)
6.	Eisenmenger complex	(?) Muller (1952)

[1] From the Department of Radiology, Stanford University School of Medicine, San Francisco, Calif. This paper was presented in part before the Eighty-third Annual Session of the California Medical Association, Los Angeles, 1954. Accepted for publication in July 1954.

TABLE IIA: COMMON CONGENITAL CARDIAC ANOMALIES: ACYANOTIC

Anomaly	Clinical Data	Physical Findings	EKG	Radiologic Findings	Angiocardiography	Cardiac Catheterization
			With Decreased Vascularity of Lung			
Pulmonic stenosis (pure)	Murmur since birth; diminished functional capacity	Systolic murmur and thrill, 2nd intercostal space	Right ventricular hypertrophy; tall peaked P waves	Right ventricle large; main pulmonary artery prominent (post-stenotic dilatation); branches small by comparison	Demonstrates site of stenosis; delayed emptying of right ventricle	Increased right ventricular pressure; low pressure in pulmonary artery
			With Increased Vascularity of Lung			
Atrial septal defect	Murmur since birth; underdevelopment; recurrent pulmonary infection	Systolic murmur, 2nd–3rd intercostal space, to left of sternum; occasional diastolic murmur; small pulse pressure; loud P_2	Right bundle branch block; right ventricular hypertrophy; tall P waves	Huge right ventricle and right auricle; left ventricle and left auricle not enlarged; huge main pulmonary artery and branches; hypoplastic aorta	Large right auricle; may demonstrate passage of opaque medium from right auricle to left auricle or late reopacification of right auricle	Increased oxygen saturation in right auricle over superior vena cava; slightly increased right ventricular and pulmonary artery pressure
Ventricular septal defect	Murmur since birth; few symptoms unless defect is high and large; then may resemble Eisenmenger complex	Loud systolic murmur, 4th intercostal space, to left of sternum	Normal, right ventricular hypertrophy, left ventricular hypertrophy; combined hypertrophy, or right bundle branch block	Heart may be normal; if defect is large and high, full pulmonary artery and branches; right and left ventricles large; aorta small	Rarely shows early staining of left ventricle; late reopacification of right ventricle	Right ventricle oxygen saturation greater than right auricle
Patent ductus arteriosus	Murmur since birth	Usually continuous murmur over pulmonic area; increased pulse pressure	Normal; rarely left ventricular hypertrophy	Increased left ventricular pulsation; some left ventricular enlargement; prominent pulmonary artery and branches; aorta normal or large; occasional left ventricular enlargement	May show ductus diverticulum and reopacification of pulmonary artery. Retrograde aortography better in infants: shows diverticulum and opacification of pulmonary artery from aorta	Increased oxygen saturation in pulmonary artery over right ventricle
			With Normal Vascularity of Lung			
Coarctation of aorta	Nosebleeds; cold legs; headache; claudication	Loud systolic murmur, widely transmitted; hypertension in collateral vessels, arms; decreased pressure in legs	Normal, or left ventricular hypertrophy	Heart size normal in 50%; left ventricle large in rest; rib notching; indented descending aorta; large left subclavian; post-stenotic dilatation displacing esophagus	Shows coarcted site. Retrograde aortography preferable	.....

TABLE IIB: COMMON CONGENITAL CARDIAC ANOMALIES: CYANOTIC

Anomaly	Clinical Data	Physical Findings	EKG	Radiologic Findings	Angiocardiography	Cardiac Catheterization
			With Decreased Vascularity of Lung			
Tetralogy of Fallot	Onset of cyanosis early in life; mild to marked; squatting	Cyanosis; clubbing; polycythemia; systolic murmur, 2nd left intercostal space	Right ventricular hypertrophy	Small "boot-shaped" heart; right ventricle large; aorta anteriorly placed; in left anterior oblique projection, pulmonary vessels small	Simultaneous filling of aorta and pulmonary artery from right ventricle; ventricular septal defect; pulmonary stenosis	Right ventricular pressure increased; pulmonary artery pressure lower than right ventricular; increased right ventricle oxygen saturation
Pulmonic stenosis with patent foramen ovale	Murmur since birth; late onset of cyanosis; dyspnea may be marked	Cyanosis mild; systolic murmur or thrill over pulmonic area	Right ventricular hypertrophy	Right ventricle large; prominent main pulmonary artery; branches small by comparison	Big right auricle and right ventricle; pulmonic stenosis; left auricle staining may be seen simultaneously with right auricle	Right ventricular pressure high; pulmonary artery pressure low; peripheral arterial oxygen unsaturation
Tricuspid atresia	Cyanosis early in life severe; early right heart failure	No characteristic murmur; cyanosis marked	Left ventricular hypertrophy	"Boot-shaped" heart, with concave pulmonary artery segment, but in left anterior oblique projection right ventricle small; decreased lung vascularity	Sequential opacification of right auricle, left auricle, left ventricle	Catheter may enter left auricle from right auricle; fails to enter right ventricle
			With Increased Vascularity of Lung			
Transposition of great vessels	Early onset of marked cyanosis	Cardiac enlargement; murmur variable	Usually right ventricular hypertrophy; occasionally left ventricular hypertrophy as well	Large heart; full lung vessels; narrow great vessel shadow, widening in left anterior oblique projection; right and left ventricles large	Aorta far anterior; fills from right ventricle; pulmonary artery filling delayed	Right ventricular pressure high; catheter may enter aorta
Truncus arteriosus	Cyanosis relatively slight	Loud systolic murmur, at times continuous	Right ventricular hypertrophy	Large right ventricle; large vessel arising from heart; pulmonary artery arising higher than usual; concave pulmonary artery segment	Single large vessel arising from heart, giving rise to pulmonary artery and branches	Catheter enters common trunk; right ventricular pressure high
Eisenmenger complex	Murmur since birth; cyanosis late in onset	Usually systolic murmur, left sternal border; loud P_2	Right ventricular hypertrophy	Overall heart size may be be normal; prominent pulmonary artery and branches; right ventricle large	Overriding aorta and big pulmonary artery and branches	Right ventricular pressure and pulmonary artery pressure high; catheter may enter aorta

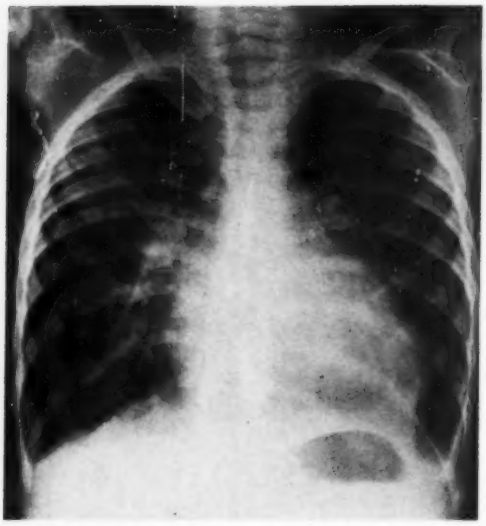


Fig. 1. Pulmonic stenosis with pulmonary plethora. This 3-year-old boy had a ventricular septal defect, with a left-to-right shunt of over 2 liters per minute (the pulmonary blood flow was 175 per cent of the systemic flow). In addition, definite pulmonic stenosis was present, with the pulmonary artery pressure significantly lower than that in the right ventricle.

The roentgenogram demonstrates gross cardiac enlargement, which at fluoroscopy and on the oblique views was seen to involve both the right and left ventricles. The pulmonary vessels are prominent both centrally and peripherally because of the increased blood flow, and there is nothing to suggest the presence of pulmonic stenosis.

matically the differential diagnostic data in the common anomalies as we apply them in practice. This is most useful in the analysis of that large group of cases which follow a fairly consistent pattern of symptoms, signs, and radiographic appearance. There will, of course, be cases in which radiologic technics must be extended beyond fluoroscopy and plain films.

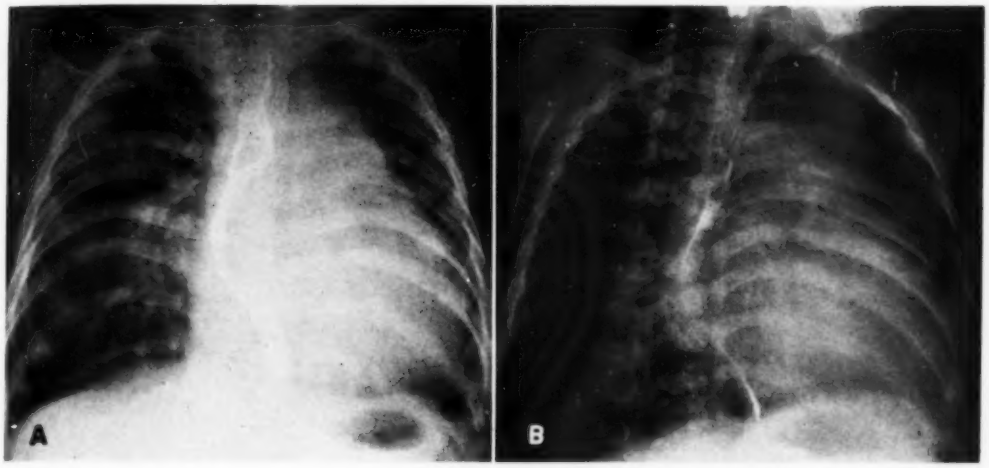
The details of diagnosis of each anomaly have been covered adequately elsewhere and do not need repetition (2, 3, 7, 26, 30, 35, 44, 50, 52, 58). Certain broad principles of diagnosis, however, and some of the individual problems in which the radiologist's knowledge and alertness may contribute substantially to the welfare of the patient deserve amplification.

THE ACYANOTIC ANOMALIES

The old and much maligned division of congenital cardiac anomalies into acyanotic and cyanotic still constitutes the foundation of differential diagnosis. The absence of cyanosis, or more particularly of significant oxygen unsaturation, eliminates the possibility of a right-to-left shunt and automatically excludes a large number of anomalies. This clinical observation is essential for proper radiologic evaluation, since there is no such thing as a pathognomonic roentgen silhouette. Once this division has been made, the next step involves an evaluation of the pulmonary vessels. The only acyanotic anomaly in which there is diminished pulmonary vascularity is pulmonic stenosis with intact cardiac septa,[2] an operable lesion. Anomalies with increased pulmonary vascularity are the left-to-right shunts, either intracardiac or extracardiac. The largest pulmonary arteries, and the greatest degree of pulsation as seen fluoroscopically, will be found in atrial and ventricular septal defects, in which there is a sudden expulsion of an increased volume of right ventricular blood into the pulmonary arteries during ventricular systole. By contrast, in patent ductus arteriosus, the arteries are smaller and pulsate less, since the flow from aorta to pulmonary artery is more gradual during both systole and diastole (13).

1. *Pulmonic Stenosis with Pulmonary Plethora:* A few puzzling cases have recently come to our attention in which radiologically the pulmonary vessels looked prominent and suggested the presence of a shunt (Fig. 1). Cardiac catheterization demonstrated pulmonic stenosis, a diagnosis we had not made; yet it also showed that a septal defect was present with a left-to-right shunt and increased pulmonary blood flow. The combination of pulmonic stenosis and elevated blood flow through the lungs sounds like a contradiction in terms, but the explanation lies in the persistence of a gradient between left ventricular and right ventricular pres-

[2] Actually, the pulmonary blood flow and the vessels are within normal limits; the "diminished vascularity" lies in the contrast between the prominent central vessels and the smaller peripheral vessels.



sure. Hence, even though the pulmonic stenosis provokes an elevation of right ventricular pressure, there will be a significant flow through a large septal defect from the higher (left) to the lower (right) pressure chamber. We have seen at least 8 such cases within the past few years, all proved by catheter study (22). Their recognition is important, since relief of the pulmonic stenosis may further elevate the pulmonary blood flow and cause flooding of the lungs. In this sense, the stenosis acts almost as a protective valve to prevent pulmonary engorgement, and its relief must await closure of the septal defect.

2. *The Atypical Patent Ductus Arteriosus:* Distinctions among the left-to-right shunts are often difficult early in life, yet may be critical. The first congenital anomaly to be subjected to successful surgical attack was the patent ductus arteriosus (31); in spite of many advances in diagnosis, infants and children continue to die when the anomaly goes unrecognized (21). In infancy, the classical murmur is rarely present (19), and the radiographic manifestations are often bizarre and atypical. Both right and left ventricular enlargement may be present, and at times the large left ventricle associated with a patent ductus arteriosus cannot be differentiated from the posteriorly displaced left ventricle usually found in the

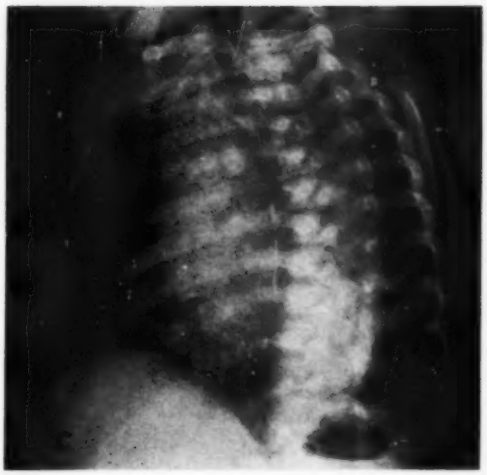


Fig. 2. Patent ductus arteriosus. This 5-month-old child had a pulmonary infection and congestive heart failure. He died two days after admission, and autopsy showed a large patent ductus arteriosus, pulmonary edema, and pneumonia.

A. Postero-anterior projection. There is gross cardiac enlargement, and the pulmonary vessels are full. The main pulmonary artery is prominent.

B. Right anterior oblique projection. The barium-filled esophagus is displaced posteriorly by the enlarged left atrium. Fullness of the outflow tract of the right ventricle is evident anteriorly.

C. Left anterior oblique projection. The enlarged left ventricle projects posteriorly and downward.

presence of a large atrial septal defect. Commonly, left atrial enlargement is demonstrable, often of a striking degree. Furthermore, pulmonary complications, which are associated both with conditions causing left ventricular failure in infancy

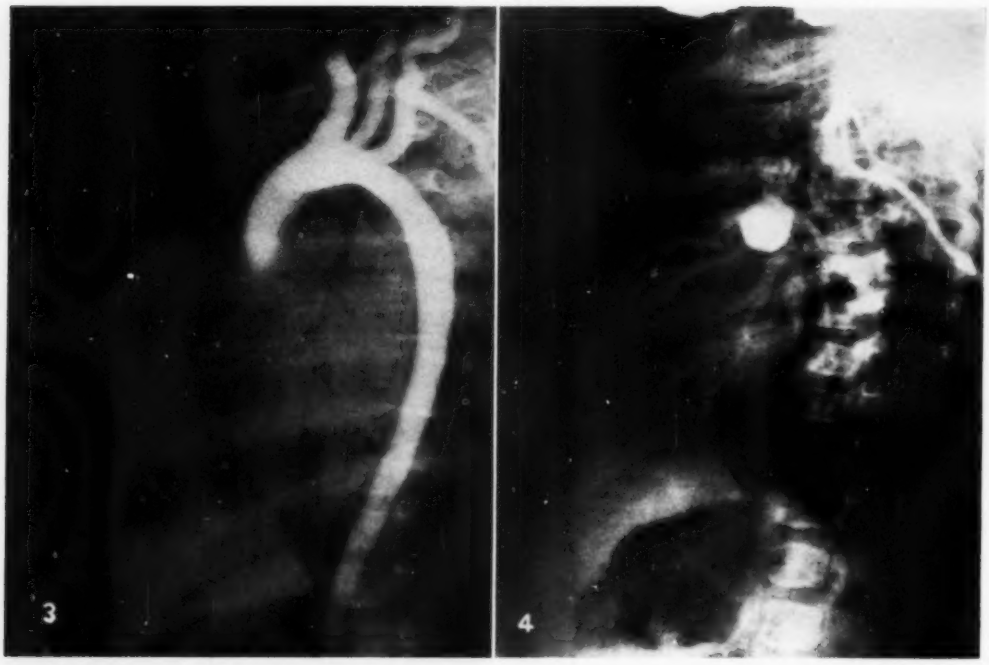


Fig. 3. Normal retrograde aortogram.
Fig. 4. Patent ductus arteriosus: retrograde aortogram. Opaque material injected through the left subclavian artery has reached the aorta and filled the pulmonary arteries through the ductus arteriosus.

(21) and with intracardiac shunts (41), are frequently present during the first year of life.

Figure 2 shows a typical example. This five-month-old infant entered the hospital because of congestive heart failure superimposed on a pulmonary infection. Roentgen studies demonstrated pulmonary plethora, biventricular enlargement, and definite evidence of left atrial enlargement. Death occurred two days after admission. Autopsy showed a large patent ductus arteriosus, pulmonary edema, and pneumonia.

After we had seen congestive heart failure develop in a number of such cases of patent ductus arteriosus early in life, a definite diagnostic pattern became apparent. Clinically, cardiac enlargement, a loud systolic murmur, and evidence of congestive heart failure and pulmonary infection are the obvious findings. The electrocardiogram may show left ventricular hypertrophy or less right ventricular hypertrophy than is usual in infancy. On the roentgenogram, biventricular enlargement, discrete left atrial enlargement, and prominent pulmonary vessels are almost invariably seen. All patients who manifest such findings are candidates for aortography, since intracardiac shunts may produce somewhat similar findings. Retrograde brachial aortography is a simple procedure during the first year of life and is probably employed less frequently than it should be (16, 40). A normal retrograde aortogram is shown in Figure 3. The diagnosis of patent ductus arteriosus is readily made by demonstration of direct opacification of the pulmonary arteries and the left heart from the aorta, as well as by visualization of the ductus diverticulum and, at times, of the ductus itself (Fig. 4).

The development of congestive heart failure in the infant with an atypical patent ductus arteriosus is by no means unique (19, 21, 40, 60). Since division or ligation of the ductus arteriosus is curable,

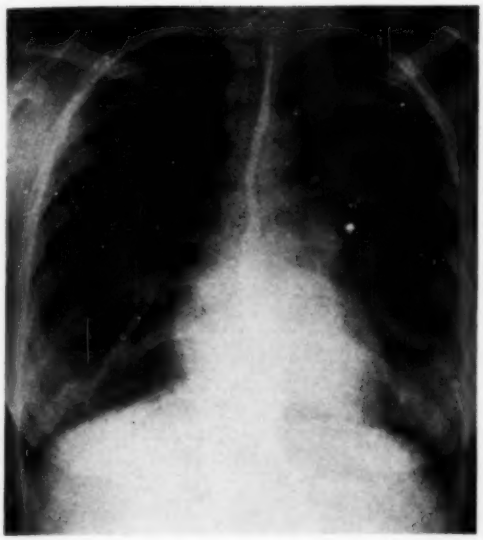


Fig. 5. Patent ductus arteriosus with reverse flow. This 16-year-old girl had cyanosis of the lower extremities but not of the upper extremities. A systolic murmur was heard, loudest over the 2nd left interspace. Electrocardiogram showed right ventricular hypertrophy. The patient was explored and a patent ductus arteriosus was found. Compression of the ductus caused a shock-like state to ensue and therefore it was not ligated.

Radiographic studies showed a normal transverse cardiac diameter and a normal aorta. The pulmonary artery segment of the left heart border was prominent and pulsated vigorously. Primary and secondary pulmonary artery branches were moderately full, but the peripheral branches were small because of endarteritis. Oblique views showed right ventricular enlargement.

Fig. 6. Patent ductus arteriosus with reverse flow: angiocardiogram and diagram. There is sequential opacification of the right atrium, the right ventricle, the pulmonary artery, the ductus arteriosus, and the descending aorta. Pre-ductal coarctation of the aorta was also present.

SVC. Superior vena cava. RA. Right atrium. RV. Right ventricle. PA. Pulmonary artery.

establishing its presence or absence is mandatory, and this is best done in infancy by radiologic procedures.

Another clinical variant of patent ductus arteriosus whose recognition is urgent is the so-called "reverse" ductus. In the presence of marked pulmonary hypertension, blood may flow from right to left through the ductus arteriosus, from the pulmonary artery into the aorta. Under these circumstances, the lower extremities will be cyanotic, and a significant difference in oxygen saturation will be found in arterial blood from the lower as compared to the upper extremity. The radiographic configuration may strongly resemble that of the Eisenmenger complex or atrial septal defect (Fig. 5). Evidence of right ventricular enlargement, rare in the uncomplicated ductus, will be seen radiographically, and the electrocardiographic pattern of right ventricular hypertrophy

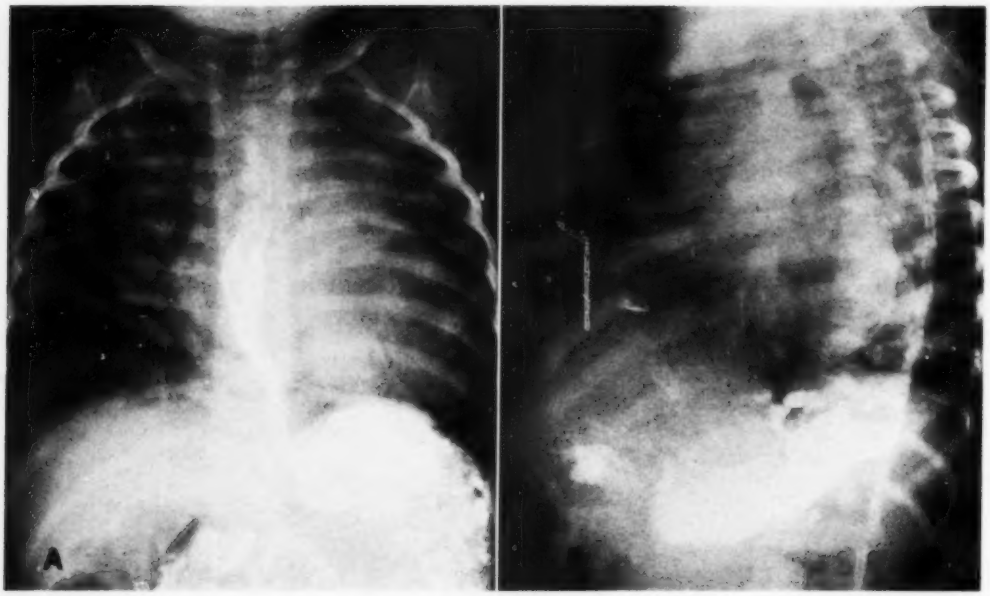


Fig. 7. Ventricular septal defect. This 10-month-old girl had an early onset of congestive heart failure. A loud systolic murmur was heard over the entire precordium. At autopsy, a large ventricular septal defect was found.
A. Postero-anterior projection. Gross cardiac enlargement and prominence of the pulmonary artery and its branches are apparent.
B. Left anterior oblique projection. The enlarged left ventricle projects posteriorly and downward. Right ventricular enlargement is also present.

is present. The small size of the peripheral vessels suggests the presence of pulmonary hypertension. Recognition is important because surgical closure of the "reverse" ductus is contraindicated and may lead to right heart failure (17, 36). Occasionally, angiocardiography may show opacification of the descending aorta from the pulmonary artery, thus demonstrating the "reverse" ductus. This is especially true of infants in whom the reverse ductus is associated with pre-ductal coarctation or interruption of the isthmus of the aorta (Fig. 6).

3. *Ventricular Septal Defect:* Recent evidence that uncomplicated ventricular septal defects may be a cause of death early in life (44), and that they may be of far more functional significance than hitherto thought (59), has accelerated efforts to evolve a satisfactory method of surgical closure (5, 38). At an early age, the ventricular septal defect may cause a rapid onset of congestive heart failure (44). The roentgen findings are those of increased pulmonary circulation and biventricular enlargement (Fig. 7). In adolescence and early adult life, the clinical and radiological findings may be almost indistinguishable from those in an atrial septal defect. In the ventricular septal defect, however, the left anterior oblique projection may show definite evidence of left ventricular enlargement (59).

The assumption that the "*maladie de Roger* as classically described is rare" (59), and that ventricular septal defects usually produce gross changes in heart size and pulmonary vessels, needs modification. It represents a reaction against the former belief that virtually all ventricular septal defects were benign lesions with no functional significance. We have recently reviewed the roentgenograms in 13 proved cases of ventricular septal defect, in only 6 of which was gross cardiac enlargement present (1). In 5 cases the heart was normal in appearance, and in 2 there was slight enlargement. The preponderant chamber enlargement was right

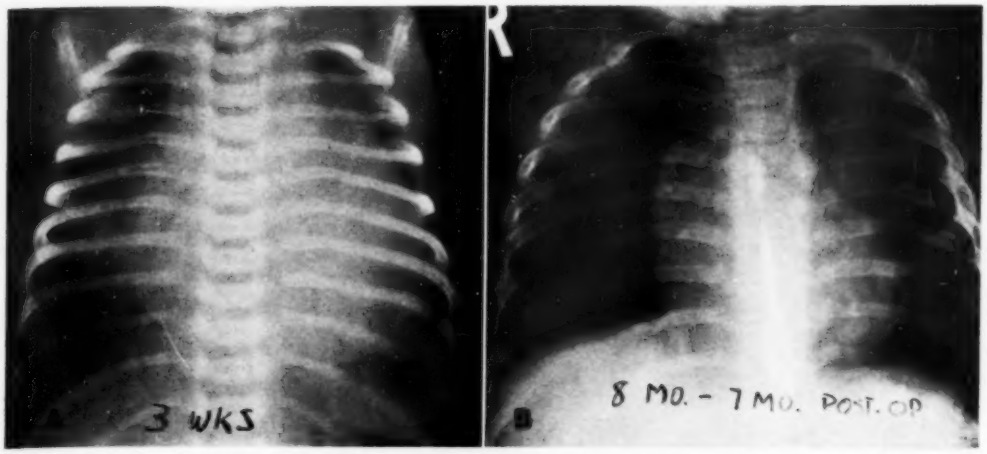


Fig. 8. Coarctation of the aorta. In this 3-week-old boy congestive heart failure developed shortly after birth. Physical examination showed cardiac enlargement, a loud systolic murmur over the entire precordium, and absence of femoral pulses. Roentgenologic studies demonstrated gross cardiac enlargement and congested lung fields, and retrograde aortography confirmed the diagnosis of coarctation of the aorta. At the age of four months, the coarcted segment was excised and an end-to-end anastomosis performed, with excellent postoperative results.
A. At three weeks, the heart is massively enlarged.
B. At eight months, seven months after operative intervention, the heart has returned virtually to normal size. Slight prominence of the ascending aorta and the left ventricle remain, and in the left anterior oblique projection there is evidence of minimal left ventricular enlargement.

ventricular, although the left ventricle was also significantly enlarged in about one-third of the cases. The main pulmonary artery was large in 10 instances, and the peripheral vessels were full in 7. The differences in appearance are obviously related to the size of the defect and the magnitude and direction of the shunt.

4. *Coarctation in Infancy:* One of the commonest causes of congestive heart failure in infancy is coarctation (21). Cases in which it is suspected must be thoroughly investigated, with remedial surgery always in mind. In the infant with congestive heart failure early in life the stenosis is usually proximal to the ductus arteriosus. If the stenosis is distal to the ductus, then during intrauterine life the blood from the ductus reaching the aorta has its normal pathway blocked and collateral vessels are established so that blood may reach the lower part of the body. When, however, the coarctation is preductal, left ventricular blood reaches the upper part of the body through the aorta, right ventricular blood reaches the lower part of the body through the ductus, and no collaterals need develop *in utero*. With closure of the ductus arteriosus shortly after birth, the left ventricle may then be unable to take care of the increased load, and heart failure may ensue (6). If the coarcted segment can be removed, however, an excellent response

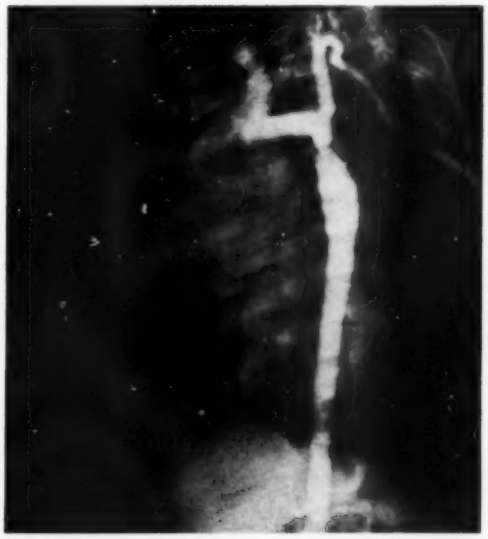


Fig. 9. Coarctation of the aorta: retrograde brachial aortography. Classical coarctation in a 4-month-old infant.

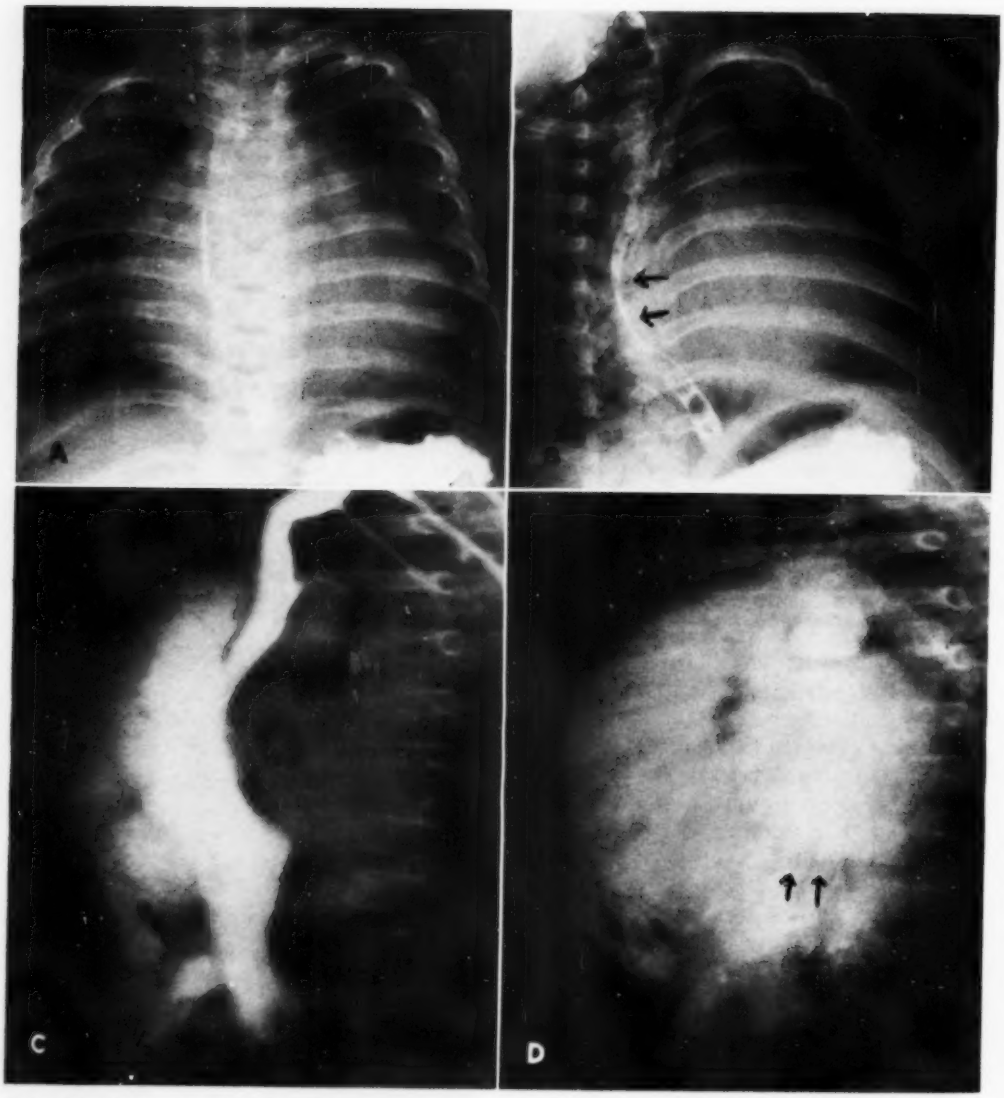


Fig. 10. Endocardial fibroelastosis in an 8-month-old child in whom congestive heart failure developed. No murmurs were heard. The electrocardiogram showed evidence of left ventricular hypertrophy and possibly of some right ventricular hypertrophy as well. Radiologic studies demonstrated gross cardiac enlargement, mainly left ventricular, with discrete left atrial enlargement also.

A. Postero-anterior projection. The heart is greatly enlarged. The pulmonary vessels are not sufficiently prominent to suggest a shunt.

B. Right anterior oblique projection. The barium-filled esophagus is displaced posteriorly by an enlarged left atrium (arrows). Some right ventricular enlargement is demonstrated by obliteration of the retrosternal space. The left oblique view showed left ventricular enlargement.

C. Angiocardiogram, left anterior oblique projection, at one and one-half seconds. The right cardiac chambers are opacified, and the right ventricle is displaced anteriorly by the enlarged left atrium.

D. Angiocardiogram, left anterior oblique projection, at five seconds. The left atrium is enlarged (arrows) and retains opaque material longer than normal.

may be anticipated (Fig. 8). We have seen dramatic decrease in heart size and return to normal following surgery under the age of one month. By means of retrograde brachial aortography, both the site of the coarctation and the length of the narrowed segment may be demonstrated (Fig. 9).

5. *Endocardial Fibroelastosis:* One of the most difficult cardiac chambers to evaluate roentgenographically in infancy is the left atrium. We have seen a number of cases in which the usual radiologic criteria of left atrial enlargement were present, yet at necropsy this chamber was not significantly enlarged. Hence a certain amount of caution must be exercised in evaluating left atrial size in the infant. On the other hand, there are relatively few anomalies in infancy which produce discrete left atrial enlargement incommensurate with the overall heart size. Congenital mitral stenosis is a rare example, and patent ductus arteriosus a more common one. Another lesion which must be considered is endocardial fibroelastosis. In this unusual disease, the endocardial thickening frequently involves the mitral valve (4). In the presence of sudden onset of heart failure in an acyanotic child with marked dyspnea, no constant murmurs, gross cardiac enlargement (10) without the prominent pulmonary vessels of a left-to-right shunt, and evidence of left ventricular hypertrophy radiographically and on the electrocardiogram (42), the demonstration of a definitely enlarged left atrium constitutes strong suggestive evidence of fibroelastosis (Fig. 10). That marked cardiac dilatation may occur is attested by the efforts to perform pericardial taps on several of these cases under the impression that an effusion was present (23). At times, the distinction from coarctation of the aorta may prove to be difficult.

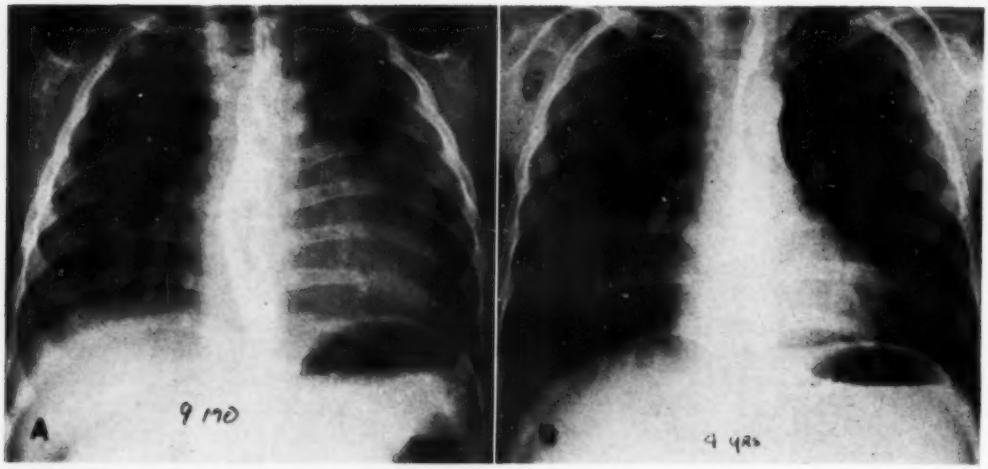
THE CYANOTIC ANOMALIES

The presence of cyanosis in congenital anomalies, except in terminal heart failure, is evidence of a right-to-left shunt, whether it be through an overriding aorta or through patent cardiac septa. As in the acyanotic anomalies, the size of the pulmonary artery and its branches is of critical importance in differential diagnosis.

Evaluation at fluoroscopy is not always easy in infants, however, and good films in inspiration must be obtained. The roentgenograms of a child of nine months with a loud systolic murmur and little disability are shown in Figure 11. Good inspiration films were not obtained initially, and the pulmonary vessels appeared prominent. The diagnosis of an interventricular septal defect was entertained. Subsequent examinations showed little change. Finally, three years after the first examination, films in good inspiration showed the silhouette of a typical mild tetralogy of Fallot; meanwhile mild cyanosis had developed. Angiocardiography and operative findings of low pulmonary artery pressure confirmed the diagnosis.

Another factor which must be carefully weighed is the presence of collateral circulation (15). This may produce a fuzzy appearance, with dense vascular shadows adjacent to the superior mediastinum or in the upper lung fields. At times, nodular shadows in the hilar regions with abnormal branching, or a reticular pattern peripherally, may be noted.

1. *Pulmonic Stenosis in Cyanotic Anomalies:* Among the cyanotic anomalies with decreased pulmonary blood flow, it is important to distinguish between the tetralogy of Fallot, in which overriding is present, and pulmonic stenosis with patent foramen ovale, since in the latter a direct surgical attack on the valve is indicated and a Blalock-Taussig operation is contraindicated (12, 37). The distinction can usually be made readily without special technic. In valvular stenosis, the disparity between the size of the main pulmonary artery—which usually shows post-stenotic dilatation—and the peripheral vessels is often striking. Angiocardiography can be helpful in demonstrating the site of stenosis, whether infundibular or valvular (Fig. 12); for this purpose, the anteroposterior



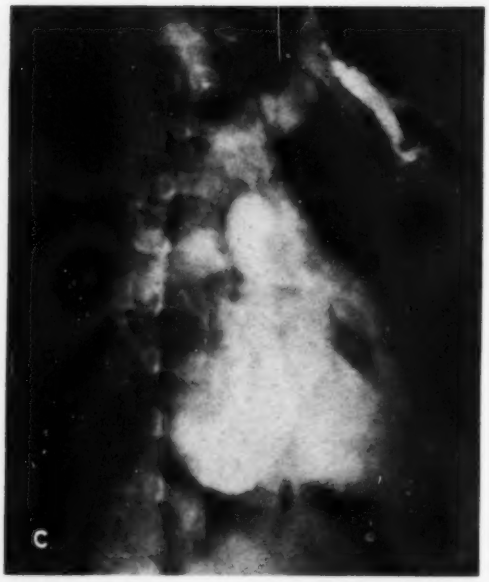


Fig. 11. Importance of adequate films in evaluation of the pulmonary vessels. Tetralogy of Fallot. This 9-month-old boy had a murmur from birth but was otherwise asymptomatic. He began to squat at about three and one-half years of age and showed mild cyanosis. Chest films at nine months and three years were not diagnostic, and the pulmonary vessels seemed slightly prominent. Both films were obtained in shallow expiration. Fluoroscopy and films at the age of four showed the classical silhouette of a mild tetralogy of Fallot confirmed by angiocardiography and subsequently at operation.

A. Nine months. Cardiac silhouette not distinctive. Possible minimal enlargement. Pulmonary vessels normal or slightly prominent. Diagnosis of ventricular septal defect was suggested. Similar findings at three years.

B. Four years. Typical silhouette of a mild tetralogy of Fallot. The pulmonary artery segment is concave and the apex elevated; there is slight but definite diminution of pulmonary vascularity.

C. Angiocardiogram, right anterior oblique projection, at two seconds. The characteristic overriding aorta and high infundibular stenosis are demonstrated.

and the right anterior oblique projections (Fig. 11) are best. To demonstrate septal defects or overriding, on the other hand, the left anterior oblique projection is most helpful (Fig. 13). One interpretive hazard which deserves comment is the occasional difficulty in angiocardiography of distinguishing overriding, as in the tetralogy of Fallot, from aortic opacification associated with pulmonic stenosis and a large septal defect. Confusion arises usually when a single projection has been utilized for the angiocardiogram, particularly an anteroposterior projection. The use of two projections, by demonstrating the septal defect and the sequence of opacification, usually obviates such errors.

2. *Tricuspid Atresia:* Tricuspid atresia is one of the few cyanotic anomalies in which left ventricular hypertrophy is found on the electrocardiogram, although by no means the only one (55). Occasionally, particularly early in life, electrocardiographic evidence of left ventricular hypertrophy may be lacking (2). Radiologically, evidence of a hypoplastic right ventricle is best shown in the left anterior oblique projection (Fig. 14). At fluoroscopy, a difference in pulsation between

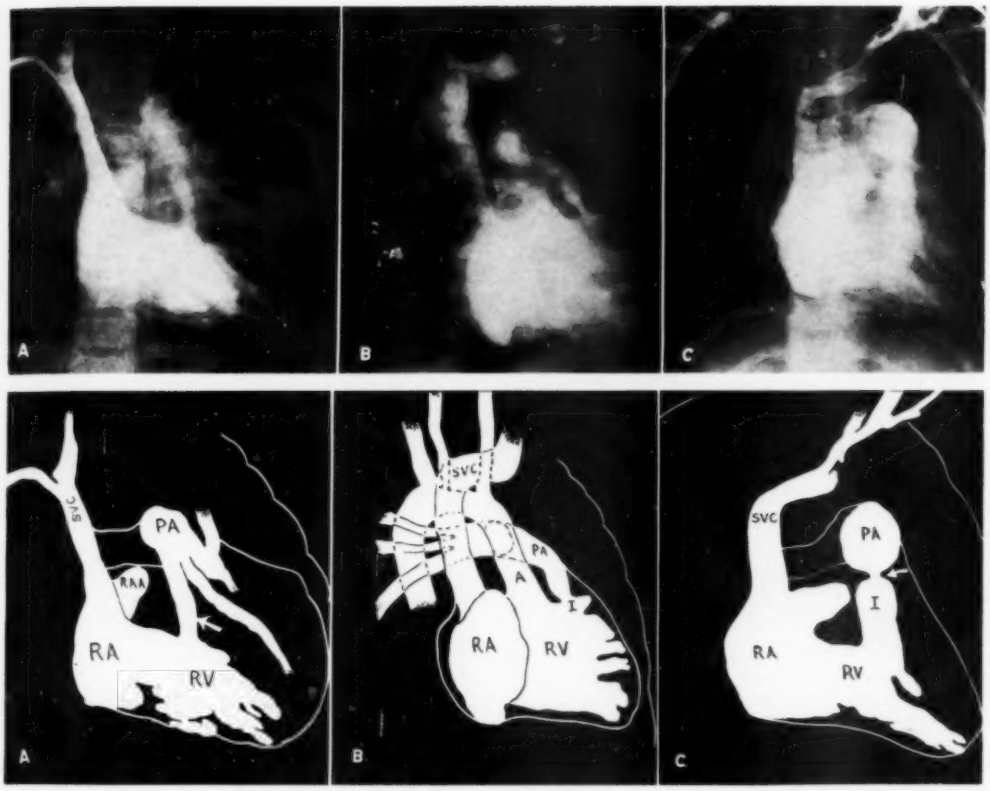


Fig. 12. The site of pulmonic stenosis. A. Long, low, infundibular stenosis. Multiple films demonstrated the area of infundibular narrowing (arrow). B. High infundibular stenosis in the tetralogy of Fallot. C. Valvular stenosis (arrow).

In Figs. 12 and 13: SVC. Superior vena cava. RA. Right atrium. RAA. Right atrial appendage. RV. Right ventricle. PA. Pulmonary artery. I. Infundibulum of right ventricle. A. Aorta. LA. Left atrium.

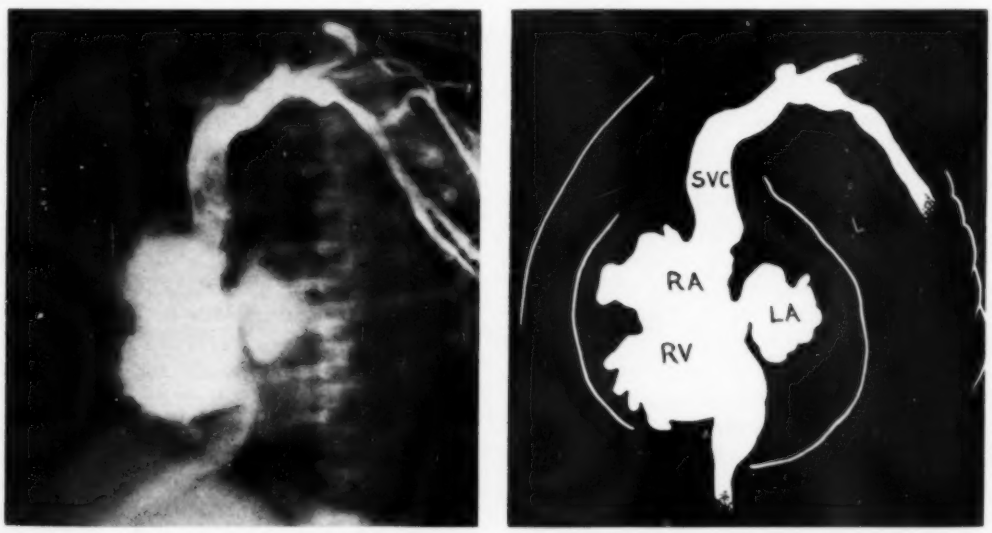


Fig. 13. Angiocardiogram, with diagram, of atrial septal defect. The opaque medium passes through the atrial septal defect from right atrium to left atrium.

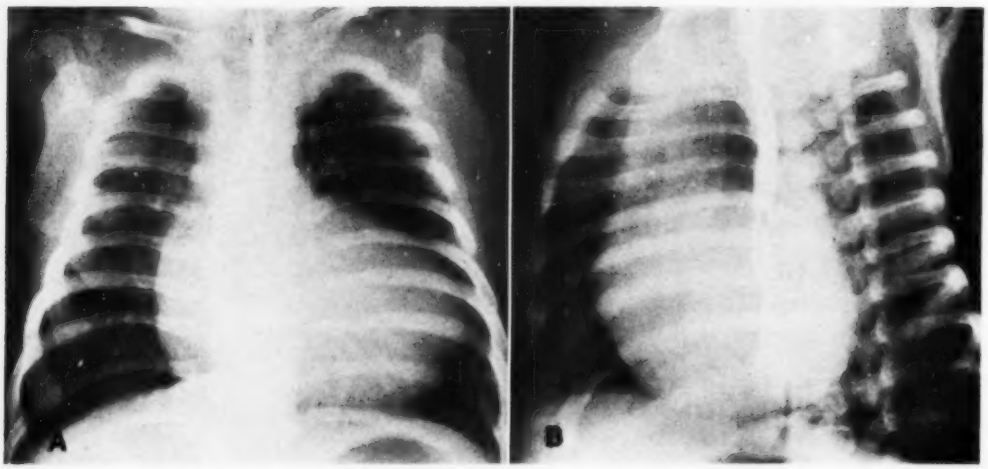


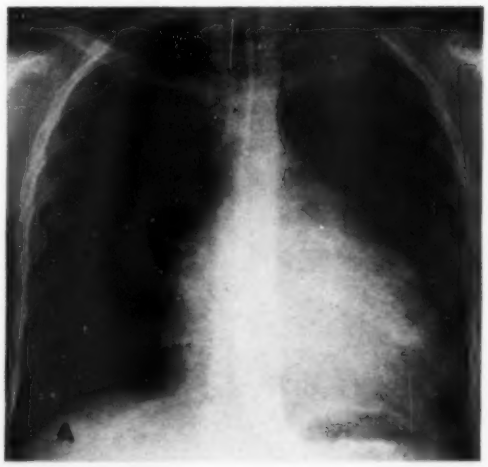
Fig. 14. Tricuspid atresia in a boy of 2 1/2 months.
A. Postero-anterior projection. The apex is slightly elevated, and the lung fields are clear. The heart size is somewhat increased.
B. Left anterior oblique projection. The prominent right ventricle seen in the tetralogy of Fallot is absent; instead, there is flattening of the anterior heart border, indicating a diminutive right ventricle. The left ventricle is enlarged.

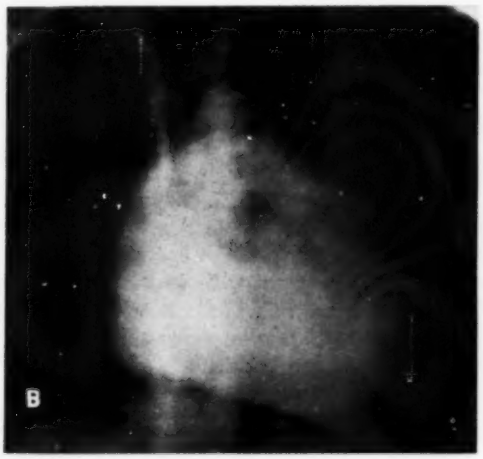
the anterior border, composed mainly of right auricle, and the posterior or left ventricular border, may be demonstrated in this projection (54). A "typical" silhouette is the exception rather than the rule, however, and careful clinical correlation is essential.

3. *Ebstein's Anomaly:* One of the rare cyanotic anomalies is Ebstein's anomaly, or downward displacement of the tricuspid valve. The valve cusps are actually not in the tricuspid valve ring but are attached to the right ventricular wall, and as a result the right atrium is grossly enlarged, and the right ventricle relatively small. Diminished pulmonary blood flow is almost invariably present, and cyanosis develops when right auricular or venous blood reaches the left heart through the patent foramen ovale. These patients are not candidates for the Blalock-Taussig operation, and death frequently follows thoracotomy (28). Furthermore, cardiac catheterization is a dangerous procedure in this anomaly (14, 24), and hence it is important that it be recognized before catheter studies are performed. The diagnosis must be entertained in a cyanotic patient with or without murmurs, with a wide globular cardiac silhouette, evidence of diminished pulmonary flow, contours incompatible with the tetralogy of Fallot, and right bundle branch block on the electrocardiogram (Fig. 15). Distinguishing Ebstein's anomaly from pulmonic stenosis with a patent foramen ovale may be difficult, and yet is critical, since the latter condition may be attacked surgically. In pulmonic stenosis, however, post-stenotic dilatation of the main pulmonary artery is usually present, and right ventricular pulsation is prominent. Since the diagnosis can be established by angiocardiography (20, 27, 28, 56), this is the procedure of choice, although it entails some risk (39). The cardinal feature is the huge right atrium, with displacement of the tricuspid notch to the left (28, 56).

4. *Pulmonary Plethora in Cyanotic Anomalies:* In the presence of increased blood flow, the pulmonary artery branches will be prominent. For practical purposes, no patient with cyanotic heart disease with plethora of the lung fields is a candidate for surgery. Surgery of cyanotic heart disease, as we know it today, consists mainly of increasing pulmonary blood flow, usually by creating an artificial

ductus; to do this in the presence of a high pulmonary blood flow would obviously overload the pulmonary circulation and throw the patient into heart failure. Since prominent pulmonary vessels constitute a contraindication to operation, the need for distinguishing among these anomalies may be questioned. Why not class them all together as inoperable? Why separate, say, complete transposition of the great vessels from truncus arteriosus? The reason is that technics of venous transplantation are even today being developed which may make transposition a correctable anomaly (43). Similarly, there are some forms of truncus arteriosus which may be helped. Such a case is





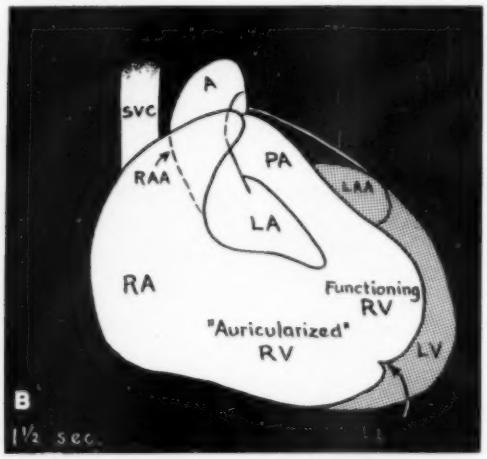


Fig. 15. Ebstein's anomaly in a 6-year-old boy.

A. Postero-anterior projection. The heart is grossly enlarged in its transverse diameter, and the right atrial border describes a long shallow arc. Pulmonary vascularity is distinctly diminished, both hilar vessels being small in caliber. Oblique projections demonstrated massive enlargement of the right cardiac chambers, with no evidence of left atrial enlargement and questionable evidence of left ventricular enlargement.

B. Angiocardiogram at one and one-half seconds, with diagrammatic tracing. The right atrium (RA) is huge, and the large right atrial appendage (RAA) is high and projects to the left of the mid-line. The tricuspid notch (arrow) is displaced far to the left. The functioning right ventricle is relatively small, but the pulmonary artery trunk is essentially normal in caliber. Its branches, however, are diminutive. Some opaque material has reached the left atrium through a patent foramen ovale, and there is staining both of the left ventricle and of the aorta as a consequence of this right-to-left shunt across the interatrial septum. Notice also the staining of the atrial appendage (LAA) along the left upper heart border. In Ebstein's anomaly, the "auricularized" right ventricle (RV) becomes functionally a part of the right atrium because of the abnormal position of the tricuspid valve.

shown in Figure 16, which also demonstrates the importance of careful preoperative consultation of radiologist, cardiologist, and surgeon. The diagnosis of truncus arteriosus was suspected on the plain films in this case and was demonstrated on the angiocardiogram (Fig. 16B). The pulmonary arteries arose from the trunk in a high position, with large vessels on the right and smaller ones on the left. Hence it was suggested that the only way this patient might be helped was by creating a shunt on the left side, where the pulmonary blood flow was diminished. Such

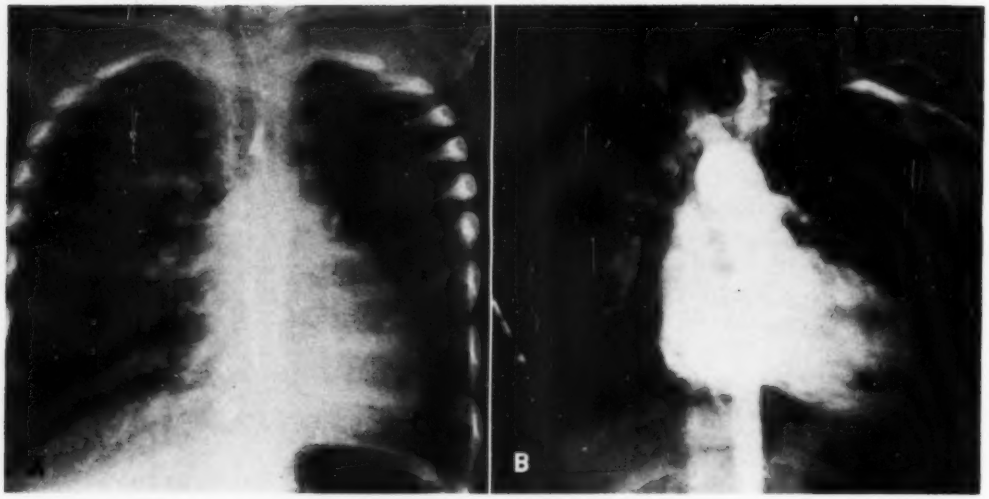


Fig. 16. Truncus arteriosus in a 4-year-old girl.
A. Postero-anterior view. The heart is grossly enlarged. Oblique views demonstrated marked right ventricular enlargement and some left ventricular enlargement. The pulmonary vessels on the right are high in position, nodular in appearance, and full. By contrast, there is a marked diminution of the vascularity.
B. Angiocardiogram in anteroposterior projection. The large trunk fills from the right ventricle. The prominent right pulmonary artery filled only after the descending aorta was opacified. The left pulmonary artery, also filling from the aorta, is small. A ventricular septal defect is present.

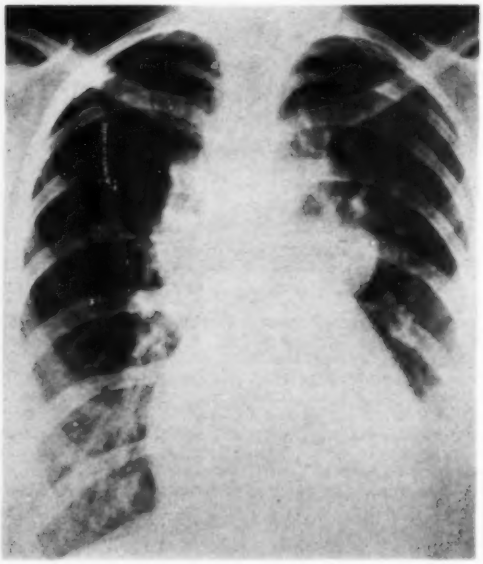


Fig. 17. Anomalous pulmonary venous return. The "figure-of-eight" shadow, made up of the heart below and dilated superior vena cava above, is quite characteristic.

a shunt might be helpful if there were narrowing of the orifice of the left pulmonary artery as it arose from the aorta, and if a pulmonary artery of adequate caliber could be anastomosed to the left subclavian artery. The patient was explored on the right, however, and a high pressure and ample blood flow were noted in the large right pulmonary artery coming off the truncus arteriosus. Thus, an anastomosis could not be performed on the right, a fact which had already been made clear by the radiologic studies.

5. *Anomalous Pulmonary Veins:* Anomalies of pulmonary venous return have attracted increasing attention within recent years (25, 48, 53). In particular, total pulmonary venous return to the right atrium, an anomaly which puts a tremendous strain on the right heart, has been demonstrated to be a recognizable entity, at least in some forms. The radiologist can occasionally suggest the diagnosis simply by inspection of the postero-anterior view, for the configuration may be quite characteristic. A "figure-of-eight," consisting of the heart below and the mediastinal silhouette above, is found when the pulmonary veins empty into a left superior vena cava which drains

into the right superior cava or the right atrium. We have seen 5 such cases within the last few years. The curved lateral borders of the superior mediastinum are formed by the dilated vena cavae. Oblique views demonstrate the presence of significant right heart enlargement. Angiocardiography demonstrates a right-to-left interatrial shunt and late reopacification of the right atrium. Unfamiliarity with this entity may lead to unnecessary irradiation of a "mediastinal mass," as happened in one of the cases we have observed, or even to thoracotomy, which was planned in an additional case. Conversely, accurate recognition becomes more important with recent advances in the technic of transplanting the great veins (45).

SUMMARY AND CONCLUSIONS

Refinements in diagnosis which have proved so important for advances in cardiac surgery have in turn created a heavy responsibility for the diagnostic team, not the least of which rests with the radiologist. Using a correlative approach, understanding and evaluating the available clinical data in relation to the radiologic findings, the radiologist may make a considerable contribution toward clarifying the value, applicability, or hazard of surgery in the individual case. Just as proper interpretation of operable congenital cardiac anomalies presents a challenge whose rewards for the patient may be great, so the penalties of improper diagnosis may be harsh. In anomalies such as patent ductus arteriosus and coarctation of the aorta, which may cause heart failure and death in infancy, the radiologist may clarify the diagnosis through the use of both routine and special procedures such as retrograde aortography, thus allowing needed operative intervention. Conversely, adequate differentiation of lesions in which operation is contraindicated, such as endocardial fibroelastosis and Ebstein's anomaly, may be life-saving.

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SUMARIO

Aspectos Radiológicos de la Enfermedad Cardíaca Operable

Los perfeccionamientos del diagnóstico que han resultado de tanta importancia en los adelantos de la cirugía cardíaca han impuesto a su vez una grave responsabilidad al grupo diagnosticador, y no la menor parte de ella recae sobre el radiólogo. Siguiendo una senda correlativa, comprendiendo y justipreciando los datos clínicos accesibles en relación con los hallazgos radiológicos, el radiólogo puede ofrecer un aporte considerable en lo tocante al valor de la cirugía en el caso dado. Así como la interpretación adecuada de las anomalías cardíacas operables plantea un problema cuya solución puede redundar en gran beneficio para el enfermo, así también las consecuencias derivadas de un diagnóstico inadecuado pueden resultar muy duras. En las anomalías, tales como el conducto arterioso permeable y la coartación de la aorta, que pueden ocasionar insuficiencia cardíaca y la muerte en la infancia, el radiólogo puede esclarecer el diagnóstico mediante el empleo de procedimientos tanto corrientes como especiales, tales como la aortografía retrógrada, permitiendo así la necesaria intervención cruenta. A la inversa, la adecuada diferenciación de lesiones en que está contraindicada la operación, tales como la fibroelastosis endocardíaca y la anomalía de Ebstein, puede salvarle la vida al enfermo.

Mucous Colon[1]

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THE syndrome of mucous colon, although controversial and beclouded by numerous issues, has been known for centuries (1). It has many synonyms, such as mucous colitis, irritable colon, spastic colon, mucocatarrhal colitis, and chronic catarrhal colitis. Its existence is often denied, especially by the pathologists, who point out that their findings are at the most those of a catarrhal type of secretory disturbance but not actual colitis.

The roentgenologist finds himself in the midst of this controversy. He is presented with a patient having legitimate symptoms and with roentgen signs of a functional disorder. How is he to translate this history and his findings to the referring clinician? Surely the patient is not normal, but neither has he ulcerative colitis. Accordingly, we have in the past few years referred to the syndrome as mucous colon, to distinguish it clearly from any form of actual inflammation such as ulcerative colitis, with the central idea of focusing attention on a condition which is often underestimated, much to the unhappiness of the patients. We are well aware, as we have indicated, that this subject is controversial. One of our major purposes in the present paper is to revive interest in and stimulate further investigation of the entire problem.

The patient generally complains of varying degrees of diarrhea with mucus in the stool. Frequently associated are abdominal pain, occasional vomiting, fullness, and belching. Sometimes other signs and/or symptoms occur, as chest pain, palpitations, sweating, dizziness, headache, tremor, etc.

The physical findings may consist of tenderness in the region of the descending colon and a firm, palpable, tube-like descending colonic segment in a thin patient. The general condition is good.

The etiology of mucous colon is not known, but there is evidence that it is a manifestation of psychological conflicts with somatic complaints referable to the large bowel. Most of the patients apparently have a labile autonomic nervous system with concomitant cardiovascular instability. According to some authors (2), mucous colon is a somatic response to nervous tensions such as fear, anxiety, and resentment, and about 50 per cent of the patients are rigid, with obsessive-compulsive patterns. Thus the trend today is to consider mucous colon a neurosis (3), that is, a form of psychosomatic disease in which the life conflict of the individual has been mediated through the sympathetic nervous system and has localized or somatized in the colon.

Roentgenologically, no abnormal structural changes are demonstrated. One may, however, find functional abnormalities as a result of three possible factors (4): the peculiar mucoid material in the colon, spasticity, and peristaltic effort. These findings may also be seen when barium is administered orally. The colon retains its normal outline, in contrast to ulcerative colitis, and there is no evidence

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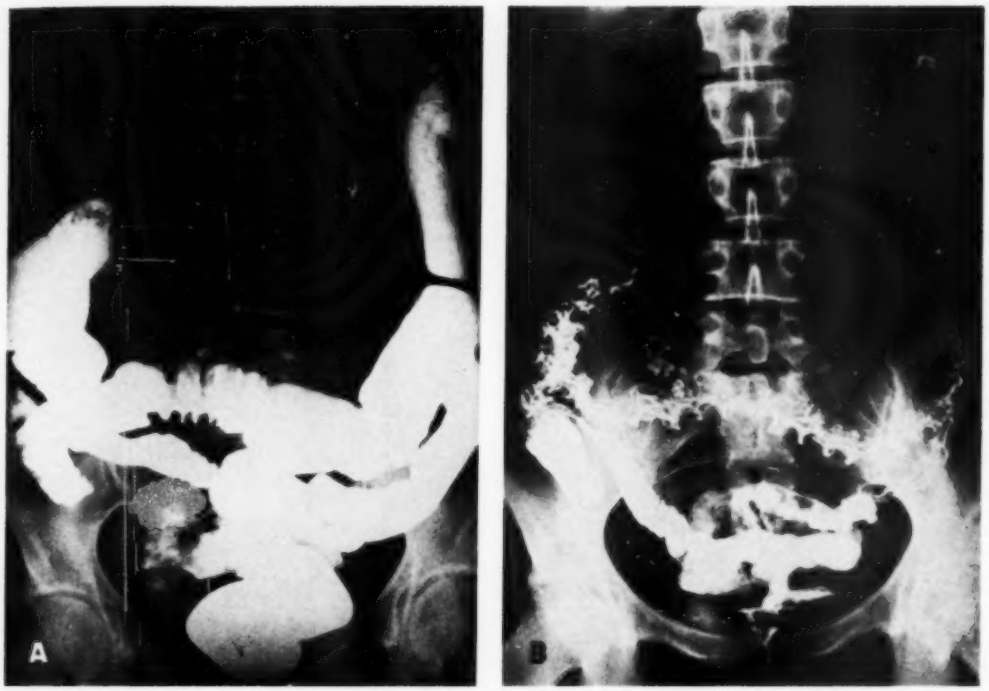

Fig. 1. Case 1. A. Barium-filled colon showing loss of normal haustral pattern, particularly in the transverse and descending portions. There is considerable mucus in the large bowel, extending to the cecal region.
B. Evacuation film showing replacement of normal pattern by enlarged mucosal folds.

of ulceration or pseudopolyposis. Kantor (5) described spastic irregularity of size, shape, and balance in spacing of haustral markings, with loss of haustration and widespread breaking up of the fecal column associated with an increased gas content.

During the past several years we have observed a number of patients complaining of diarrhea associated with the passage of mucus. These patients showed no ulcerations roentgenologically or on sigmoidoscopy; they had no fever or leukocytosis and were not seriously ill. The barium enema studies generally revealed no excessive irritability, although at times some spasm was present in the descending colon, particularly in the sigmoid. The contour of the large bowel was within normal limits and there was no evidence of ulceration. The mucous content of the colon was manifested by radiolucent, contiguous, almost miscible defects in the barium column. In some instances these defects seemed to replace the barium in the bowel, presumably due to a thorough mixing of the mucous content with the medium. After evacuation, the roentgenograms showed the mucosa to be thickened as the result of "white" edema, presumably due to hypersecretory activity of the mucous glands. At times, the increased mucous content so obscured the mucosa that very little or no mucosal pattern was defined. Barium meal studies frequently disclosed evidence of considerable motor dysfunction of the small intestine. In these instances, we noted zones of dilatation, narrowing, segmentation, flocculation, and distortion of the mucosa. Increased mucus content was frequently seen in a terminal ileal segment, with ballooning and stasis. This may be due to reflux.

The typical case of mucous colon occurs in a young or middle-aged individual in good general health, with a presenting

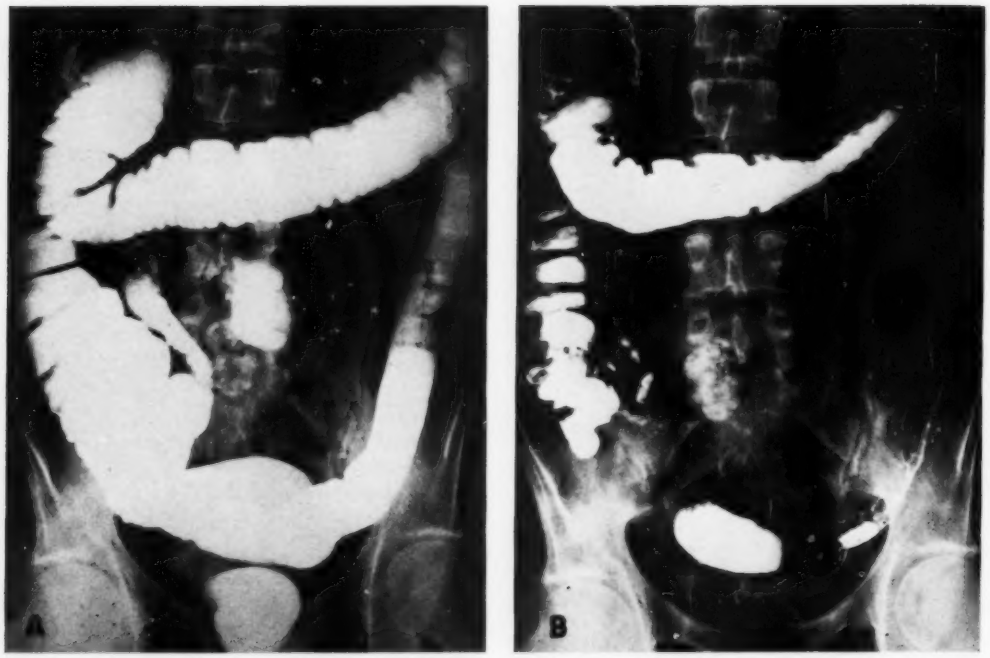

Fig. 2. Case 5. A. Mucus in the large intestine and terminal ileum; loss of haustral pattern in descending colon.
B. Failure to demonstrate mucosal pattern in descending colon on post-evacuation study. Enlarged mucosal folds are noted in the sigmoid region.

Fig. 3. Case 8. A. Barium-filled colon containing large quantities of mucus throughout. Lesser amounts are present in the terminal ileum.
B. Post-evacuation study with poor demonstration of the mucosal pattern. When visualized, the mucosa presents a thickened, distorted appearance.

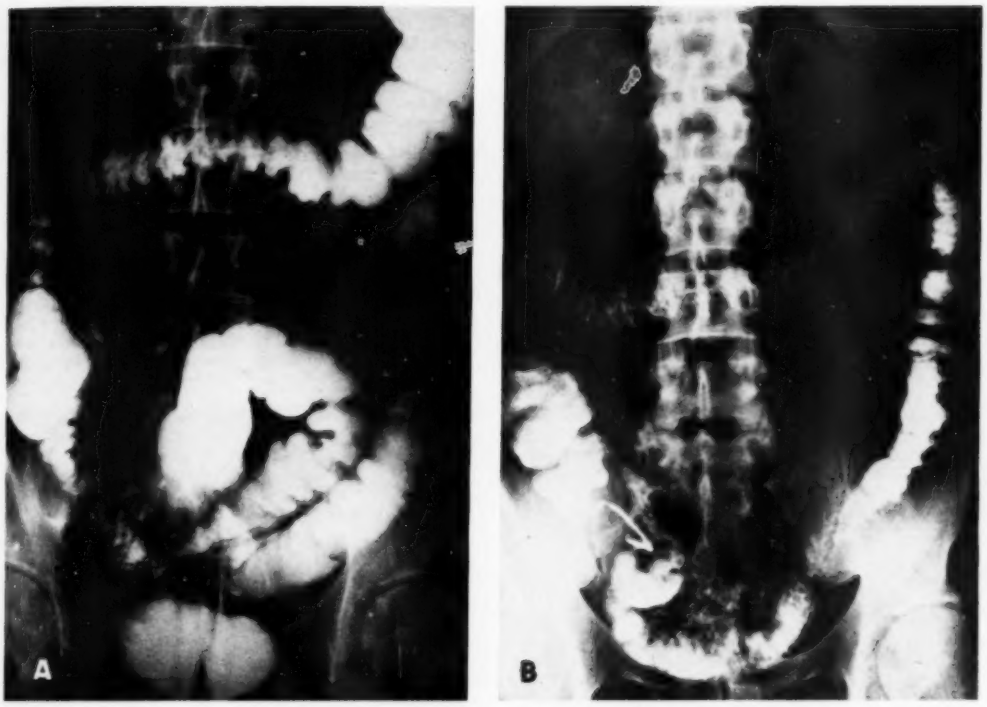

Fig. 4. Case 9. A. Considerable amounts of mucus in the large bowel and terminal ileum (pre-evacuation study).
B. Post-evacuation film demonstrating enlarged and distorted mucosal folds.

complaint of diarrhea and passage of mucus. Rectal bleeding may be present, but usually only in the form of blood flecks. Such an individual is frequently beset with emotional difficulties and may complain also of other psychosomatic symptoms, such as palpitations, chest pain, dizziness, etc. Physical and laboratory examinations are, as a rule, non-productive, and there is no systemic or local evidence of an inflammatory process. Sigmoidoscopic examination reveals at most a "white" edema with excessive mucus production, but no ulcerative or other inflammatory disease. Barium enema studies usually show normal passage of barium through the large bowel, with no gross defects or obstruction except increased mucus. On post-evacuation studies, the mucus usually obscures the mucosal pat-

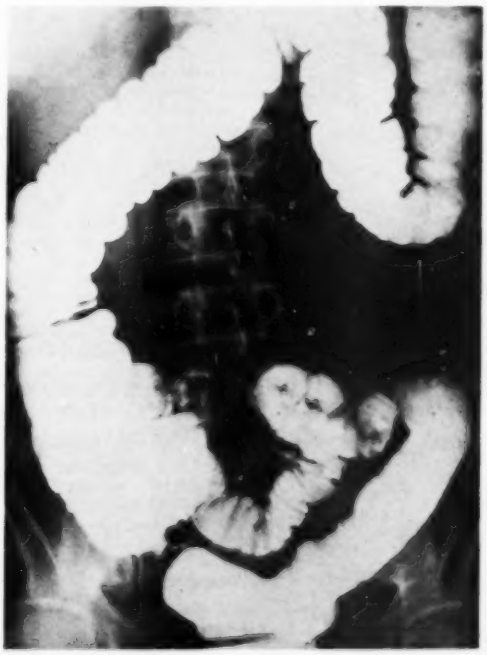

Fig. 5. Case 10. Excessive mucoid material throughout large bowel, extending into terminal ileum. →

TABLE I: MUCOUS COLON: CASE HISTORIES OF SEVENTEEN PATIENTS

Case	Age and Sex	Complaints	Findings, Proctoscopy and/or Sigmoidoscopy	Barium Enema Findings
1. M.L.D.	34F	Diarrhea of one year duration, with mucus and occasional blood. Intermittent abdominal pain and fatigue	Negative except for excessive mucus in bowel	Diminution in haustral pattern in left colon. Mucus in bowel to cecum. Normal mucosal pattern
2. T.G.	49M	Previously treated for duodenal ulcer. Two months history of diarrhea with mucus and occasional blood streaking	Large amounts of mucus in rectum; granular mucous membrane	Irritable sigmoid. Retained mucus in bowel up to terminal ileum. Distorted and enlarged mucosal folds
3. H.G.	24M	Low abdominal pain for several weeks. Diarrhea three days with flecks of blood on one occasion. Much mucus in stools	Hyperemic mucosal membrane	Mucus extending to terminal ileum. Mild motor dysfunction of small intestine
4. J.A.M.	26M	Intermittent diarrhea five years. Lower abdominal pain. Ten bowel movements daily, with brownish mucous material	Normal colon on proctoscopy	Ptosis of colon but no organic abnormality. Mucus throughout bowel. Motor dysfunction of small intestine
5. R.W.	33M	Recurrent right lower quadrant pain for ten years. Diarrhea several months each year for eight years. Mucus in stool	None performed	Excessive mucus up to terminal ileum. Motor dysfunction and irritable small bowel. Failure to visualize mucosal pattern on post-evacuation study
6. V.B.	24M	Diarrhea three and a half years with occasional blood streaking; mucus always present in stools	Small amount of blood flecks and mucus in colon	Failure of visualization. Excessive mucus up to hepatic flexure of large bowel
7. C.N.	53M	Twenty-year history of intermittent diarrhea, with lower abdominal pain. Occasional flecks of blood and mucus in stool	Mucous membrane reddened. No ulceration	Irritable sigmoid and spastic colon. Enlarged and distorted mucosal folds
8. J.C.	49M	Diarrhea of four weeks duration; vague abdominal pain; watery stool with occasional flecks of blood and mucous strands	Negative	Spastic sigmoid colon. Thickened mucosal folds. Mucus prevents demonstration of mucosa
9. R.J.	30M	Severe diarrhea, one year, accompanied by lower abdominal pain and occasional chills. Mucus	Negative	Mucus in descending colon. Large mucosal folds. Spiculation in descending colon
10. S.F.	57M	Intermittent diarrhea with large amounts of mucus and occasional blood streaks, nine years. Right upper quadrant pain accompanying diarrhea	Suggestive petechiae in mucosa but no ulcerations	Large bowel intolerant to barium. Loss of haustrations in descending colon. Failure to demonstrate mucosa. Excessive mucus retained throughout
11. A.B.	39M	Three-year history of cramps, with diarrhea and mucus in stools. Free passage of mucus without diarrhea	Injected mucosa	Transient zones of spasm in transverse colon. Retained mucus. Distorted enlarged mucosal folds
12. G.W.	44M	Intermittent constipation and diarrhea, every two weeks for two and a half years. Mucus. Generalized abdominal pain	Negative	Slight ironing out of mucosal pattern along descending colon. Retained mucus in descending colon
13. G.L.	35M	Nausea, vomiting, and watery diarrhea, associated with abdominal cramps and passage of mucus, one year	Negative	Small amount of mucus in descending colon. Thick mucosal folds. Excessive mucoid material in terminal ileum
14. A.E.	44F	Mucoid material in stool, four months; occasional blood streaking	Rugal folds and mucosa covered with mucus; bowel edematous	Thickened mucosal pattern. Excessive mucus production

TABLE I: MUCOUS COLON: CASE HISTORIES OF SEVENTEEN PATIENTS—*Cont.*

Case	Age and Sex	Complaints	Findings, Proctoscopy and/or Sigmoidoscopy	Barium Enema Findings
15. J.K.	35M	Intermittent diarrhea alternating with constipation, seven years. Many mucus shreds in stools	Excessive mucus production and bowel edema	Irritable descending colon. Enlarged mucosal folds. Retained mucoid material throughout large bowel
16. J.G.	57M	Intermittent bleeding per rectum, with mild lower abdominal pain, associated with mucus in stools, recurrent for one-month periods, eight years	Mucosa thickened and indurated mucoid material present	Slight irregularity of mucosal pattern. Irritation and evidence of retained mucus in large intestine
17. A.M.L.	41M	Intermittent diarrhea, five years. Occasional blood flecks in stools	None performed	Irritation and intolerance to barium. Mucus in colon and cecum

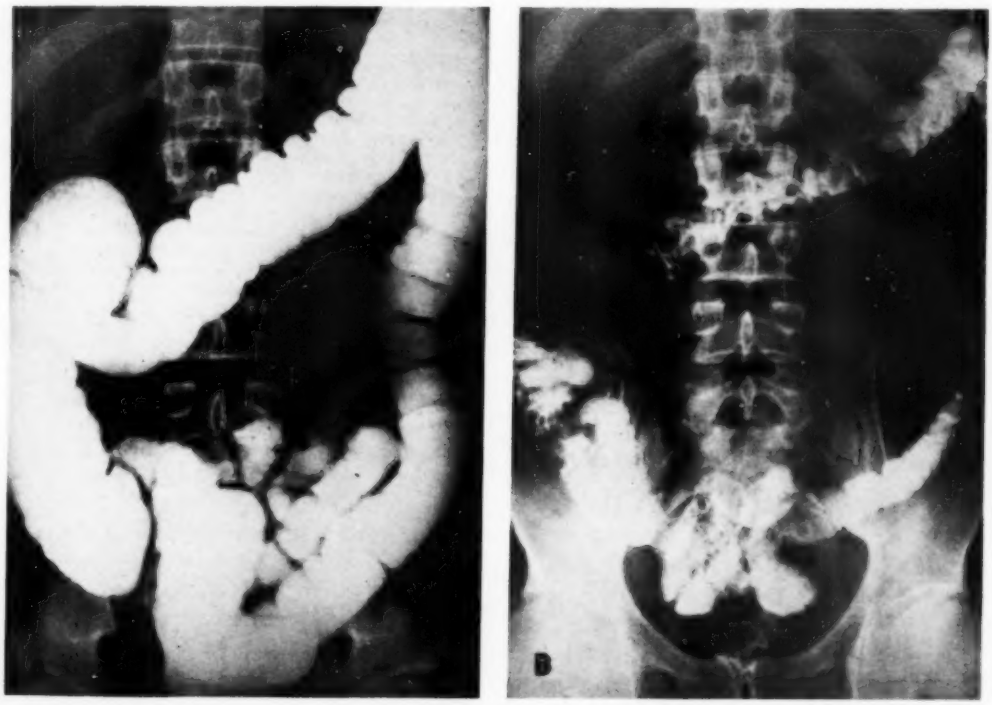

Fig. 6. Case 13. A. Pre-evacuation film showing mucus in the large bowel as well as in the terminal ileum. B. Thickened mucosal pattern (post-evacuation study), extending throughout the large intestine.

tern. If visualized, it may be temporarily due to "white" edema. Barium meal studies frequently demonstrate non-specific motor dysfunction of the small bowel. There may be mucus in the ileum, possibly due to reflux.

We have collected 17 cases of mucous colon which meet the criteria listed above. Stool studies were consistently negative for ova and parasites. The sigmoidoscopic studies revealed no evidence of ulceration and were either completely normal or showed only excessive mucus. In addition to diarrhea and the passage of mucus, 8 of our patients gave a history of rectal bleeding of varying degree. The bleeding was always mild and generally consisted of "spotting" or "streaking." We feel that this small amount of bleeding is related to undetected hemorrhoids, ex-

cessive straining, or the mechanical irritation from frequent bowel movements, use of toilet tissue, etc. Table I summarizes the pertinent data for the 17 cases.

DISCUSSION

Our purpose in presenting this brief paper is to bring into focus a frequently confusing entity which deserves more attention. The roentgenologist is in a position to establish the diagnosis of mucous colon if he is properly aware of the clinical and roentgen features. We would like to stress that there is no apparent relationship between mucous colon and ulcerative colitis. In none of the 17 cases that we have observed has there been any general or localized evidence of inflammatory disease, the sigmoidoscopic findings never showed ulcerative disease, and the barium enema studies were specific for mucous colon, with no evidence of ulcerative colitis. In not one of our cases has ulcerative colitis developed, although these patients have been followed for varying periods up to eight years.

SUMMARY

The syndrome of mucous colon consists essentially of diarrhea of varying degree, with the passage of mucus. Its etiology is not known, but it appears to be a form of psychosomatic disease. No abnormal structural changes are demonstrable roentgenologically, but certain functional abnormalities may be observed. The mucus content of the colon is manifested by radiolucent defects in the barium column and post-evacuation films may show thickened mucosa, with distorted folds.

Seventeen cases are tabulated.

The condition bears no relation to ulcerative colitis.

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SUMARIO

Colon Mucoso

El síndrome del colon mucoso consiste en el fondo en diarrea de variada intensidad, con expulsión de mucosidades. No se conoce la etiología, pero parece ser una forma de afección psicosomática. No se distinguen roentgenológicamente alteraciones histológicas anormales, pero pueden observarse ciertas anomalías functionales. Las mucosidades contenidas en el colon se traducen por defectos radiolucientes en la columna de bario y las radiografías tomadas después de la evacuación quizás revelen mucosa espesada. En algunos casos, el patrón de la mucosa se ve eclipsado por el exceso de mucosidades. Los estudios con la comida de bario muestran frecuentemente signos de disfunción motora.

Los AA. tabulan sus observaciones en 17 casos. La dolencia no guarda relación alguna con la colitis ulcerativa.

Bilateral Bronchography

New Material and Technic[1]

CESARE GIANTURCO, M.D., and GEORGE A. MILLER, M.D.

BECAUSE OF THE more stringent requirements of modern chest surgery, complete bilateral bronchograms are requested more frequently than a few years ago. This prompts a re-evaluation of the contrast media now available and of the technics employed in the complete mapping of the bronchial tree.

For many years, iodized oils have remained the opaque materials of choice. These are usually well tolerated, but their disadvantages become apparent when the opaque oil droplets, retained in the terminal bronchioles or in the alveoli, interfere with further examination of the lungs or when some patient proves allergic to iodine. Both of these disadvantages are enhanced when the injection involves the entire bronchial tree.

To avoid the persistent "lung stain" of iodized oils, some European workers have been using water-soluble absorbable iodine preparations (3). These preparations are absorbed very rapidly, usually in a few minutes, and do not cause any persistent lung opacity. The very speed of absorption, however, increases the dangers of iodine sensitivity and makes the examination a hurried procedure. Aqueous preparations have the further disadvantage of being much more irritating to the bronchial mucosa than iodized oils. For this reason, the examination requires a larger amount of anesthetic, and this increases the danger from cocaine or its derivatives. It is probably best to limit the use of water-soluble media to the injection of a small bronchial territory and to record the fleeting visualization on spot films.

Along with water-soluble contrast media, English workers have developed a slowly absorbable preparation called Dionosil oily. This medium has been used for about two years in England and South America, and reports have been uniformly favorable (1, 2). Our experience (involving 25 bilateral bronchograms) parallels that of others. Dionosil oily[2] is a 50 per cent suspension of the crystals of n-propyl ester of 3:5-diiodo-4-pyridone-N-acetic acid in arachis oil. The opacity is similar to that of the iodized oils. The new preparation, however, is absorbed in three to five days, leaving no "lung stain."

The injection of Dionosil oily is no more irritating than that of iodized oil and requires no more anesthetic. Probably because of the size of the crystals, Dionosil does not penetrate the terminal bronchioles nor the alveoli, and most of the material is expelled by coughing. The remaining material is absorbed after hydrolyzation without liberation of free iodine. This makes it possible to employ Dionosil even in iodine-sensitive patients.

Regardless of the contrast medium employed, the technic of injection should also be reviewed for greater reliability and ease of performance. Ordinarily, complete bilateral bronchograms are obtained by the successive employment of multiple positions. For best results, this method requires spot-filming of each bronchial territory as it is filled. The procedure is lengthy, tiring to the patient and doctor, and the visualization is often spotty and incomplete.

Bilateral bronchography can be facilitated and considerably improved by the simultaneous filling of all the bronchi of each side. This is done by injecting a measured amount of contrast material through an intratracheal catheter as rapidly as possible (in four to six seconds), in

[1] From the Section on Diagnostic Roentgenology, Carle Hospital Clinic, Urbana, Ill. Accepted for publication in July 1954.

[2] Dionosil oily was obtained for clinical trials through the courtesy of the Glaxo Laboratories of London, England, and the Picker X-ray Corporation.

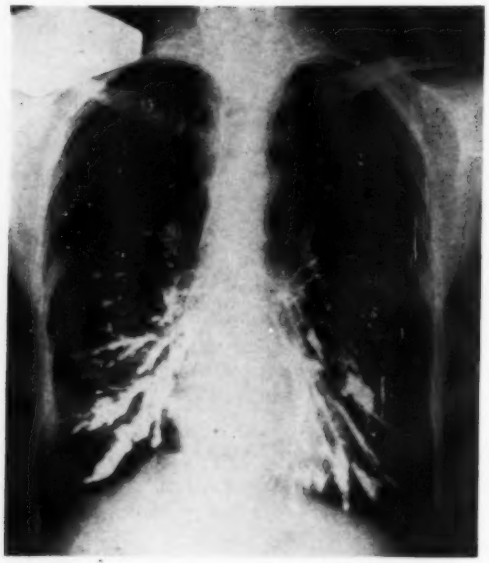

Fig. 1. Bilateral bronchogram obtained with Dionosil oily. One week later the Dionosil had been completely eliminated.

lateral decubitus, with the patient tilted upward about 10 degrees. It must be noted that this rapid injection is dangerous if the catheter tip is lodged in one of the minor bronchi. It is important, therefore, that the tip of the catheter be placed about 2 cm. above the carina under accurate fluoroscopic guidance.

The purpose of the rapid injection is to fill the dependent main bronchus and cover the mouths of all of its branches at once. If this is done, the opaque medium is aspirated toward the periphery and attains a uniform distribution throughout the bronchial tree. A few seconds after filling one side, the patient is turned on the opposite side for the injection of the other main bronchus. The total amount of opaque material varies from 8 to 20 c.c. per side, according to the size of the lungs as judged from previous chest films. After a rapid fluoroscopic check, additional material may be injected in localized areas, if needed, by opportune positioning of the patient. The catheter is then withdrawn.

In spite of the massive injections and rapid filling, it is interesting to note that the patients experience no drowning sensation nor other great discomfort. This must be due to the fact that air is still present in the peripheral branches when the contrast medium fills the larger bronchi. Fluoroscopic study shows that, as air is absorbed by the lung, the medium is aspirated toward the periphery, but, before reaching it, is spent almost entirely in wetting the bronchial walls. If the amount injected has been correctly estimated, very little opaque material reaches the smaller ramifications. For this reason, there is little or no interference with the function of the lungs during or after the injection.

As soon as the injection is finished, films are taken with the patient upright in postero-anterior and slight right and left oblique positions, with Camp grid cassettes for better contrast. The films (Fig. 1) show the larger bronchi in double contrast. The distribution of the opaque medium in the lesser branches is usually quite uniform.

The rapid injection technic may be used with any contrast medium. Even when iodized oils are employed, alveolar filling and subsequently "lung stain" are reduced to a minimum. An intratracheal catheter is essential for this method of injection. This catheter may be introduced by the radiologist himself with the help of a special instrument (Fig. 2) consisting of a metal channel curved so as to direct the catheter toward the larynx. To this channel are attached a laryngeal mirror, an electric seed lamp, and a tongue depressor. After the local anesthesia is complete, the operator lubricates the catheter with mineral oil, heats the mirror over an alcohol lamp, and introduces the instrument so that the epiglottis and larynx come into view. Using his right thumb, he feeds the catheter into the channel so that it enters the larynx under visual control. Once the catheter is in place, the operator transfers the instrument to his left hand and uses his right index finger to free the catheter. This is left in position, to be held by the patient between his lips. The instrument is withdrawn. The patient is now asked to lie supine and is fluoroscoped so that the

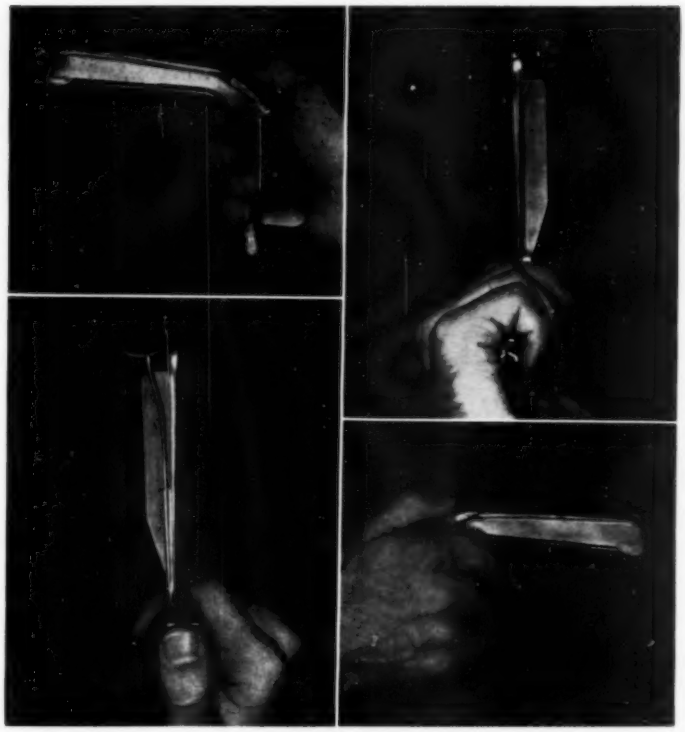

Fig. 2. Four views of the instrument for tracheal catheterization. Note how the catheter is rolled under the thumb. The seed light at the end of the instrument allows visualization of the larynx through the mirror. The tongue is held down by the depressor. The catheter is disengaged by lifting it from the metal channel.

tip of the catheter may be properly positioned about 2 cm. above the carina.

The technic described above and the use of Dionosil oily have made complete bilateral bronchography a relatively simple and reliable procedure, reducing discomfort to the patient and avoiding the persistent "lung stain" so often seen after the use of iodized oils.

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SUMARIO

Broncografía Bilateral: Nuevas Substancia y Técnica

El Dionosil oleoso, suspensión al 50 por ciento de los cristales del éster n-propilico del 3:5-biyodo-4-piridona-N-ácido acético en aceite de cacahuete, ha sido usado para 25 broncogramas bilaterales con resultados favorables. Se absorbe en tres a cinco días, sin que deje una "mancha pulmonar," como la observada con los aceites yodados.

Se facilita la broncografía bilateral y se obtienen mejores resultados con el henchimiento simultáneo de todos los bronquios de uno de los dos lados. Se logra esto

con la inyección rápida (cuatro a seis segundos) de una cantidad medida (9 a 20 c.c. en cada lado) del medio a través de una sonda intratraqueal, con el enfermo en decúbito lateral e inclinado unos 10 grados hacia arriba, colocándose la sonda bajo orientación roentgenoscópica con la punta unos 2 cm. más arriba de la quilla. A los pocos segundos del henchimiento de un lado, se voltea al enfermo del lado opuesto para la inyección del otro bronquio mayor. Un instrumento especial en forma de conducto metálico encorvado de modo que encamine la sonda hacia la laringe ha resultado útil para la introducción de la sonda.

Las radiografías tomadas con el enfermo erguido en las proyecciones antero-posterior y oblicuas derecha e izquierda, con los chasis de rejilla Camp, muestran los bronquios mayores en doble contraste. La distribución del medio en los bronquios más pequeños suele ser bastante uniforme.

The Relationship of the Left Atrium to the Opacified Esophagus in Upright and Recumbent Positions[1]

CHARLES M. NICE, JR., M.D., and C. WILLIAM HALL, M.D.

IT HAS LONG BEEN recognized that the close apposition of the posterior surface of the left atrium to the anterior wall of the thoracic esophagus is of diagnostic significance in evaluating enlargement of this cardiac chamber. Earlier investigators (4, 6, 7, 10, 11) have demonstrated adequately the importance of examination of the barium-opacified esophagus, not only in diseases of the heart and aorta but also in differentiating lesions of the right and left sides of the heart. Mitral valvular disease—stenosis, incompetence, or both—is the most common cause for left atrial enlargement. Dilatation of the left ventricle, auricular fibrillation, patent ductus arteriosus, and interventricular septal defect may produce functional changes which enlarge the left atrium.

The above conditions do not always cause sufficient left atrial enlargement to produce esophageal deviation in the upright patient (2). Kjellberg (3) believes that lesser degrees of enlargement may become manifest with the patient prone, since in this position the venous return is increased and the left atrium is filled to its fullest extent. Schorr, Dreyfuss, and Schwartz (8) indicated that the right anterior oblique view with the patient recumbent may also reveal enlargement not demonstrable in the upright position.

There are few references in the medical literature regarding use of the horizontal esophagram to detect early left atrial enlargement. Segers and Brombart (9), in their monograph, state that they consider it a valid procedure. Caffey (1) does not mention the recumbent position in this connection.

Relatively little investigation has been carried out in normal subjects, so that most of the studies which have been made lack adequate control. Kjellberg mentioned no controls. Schorr *et al.* stated that "a group" of normal persons was examined, but did not say how many. For this reason it seemed pertinent to examine a series of normal individuals in order to determine whether changing position affects the relationship of the left atrium and the opacified esophagus.

DESCRIPTION OF METHOD

One hundred normal young adults were examined, including males and females, with an age range of twelve to thirty-eight years. In each instance evidence of cardiac disease was excluded by a careful history and physical examination. Most of these individuals had multiple physical examinations, including several chest roentgenograms, and were entirely normal. The following radiographs of the chest were taken following a swallow of barium: (*a*) postero-anterior projection, patient upright; (*b*) right lateral projection, patient upright; (*c*) right lateral projection, patient prone; (*d*) right lateral projection, patient in right lateral recumbent position. The examinations were carried out with the patient maintaining full inspiration and with a target-film distance of 6 feet. For tabulating purposes the amount of esophageal deviation was classified as follows:

0. No deviation.
E. Equivocal or very slight deviation.
1. Moderate deviation.
2. Pronounced deviation

It is realized that there is considerable subjective influence in evaluating the degree of displacement. It is notable that no extreme degrees of displacement, such

[1] From the Department of Radiology, University of Minnesota Medical School, Minneapolis, Minn. This investigation was supported by a grant from the Graduate School of the University of Minnesota. Accepted for publication in July 1954.

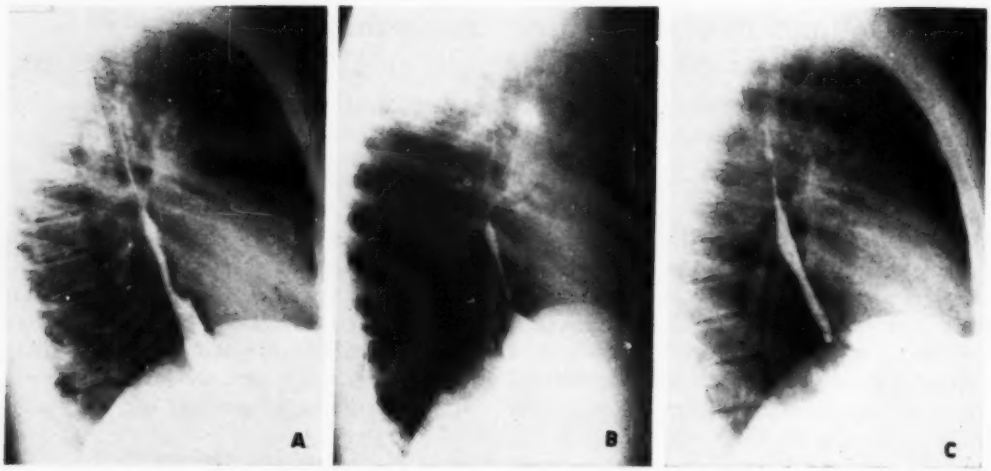

Fig. 1. Typical normal individual, with no deviation of the esophagus in the upright (A), prone (B), or right lateral recumbent (C) position.

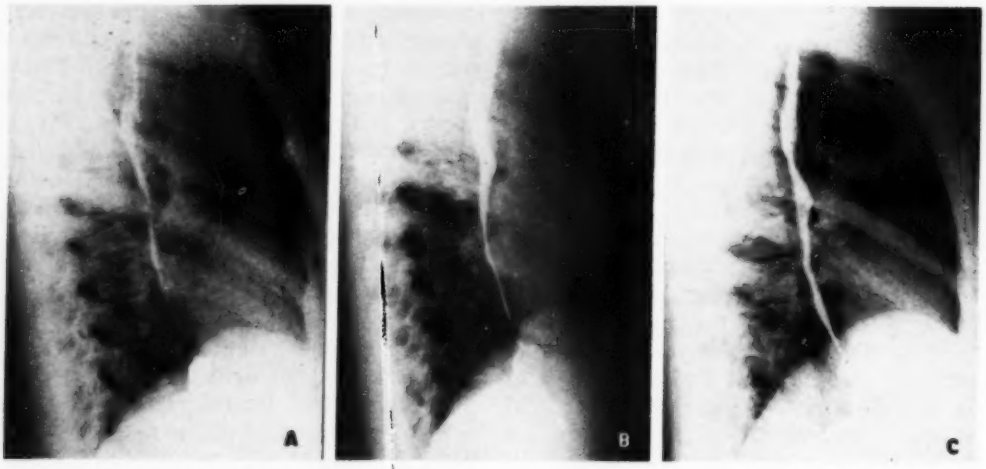

Fig. 2. Normal variation in relation of esophagus to left atrium. No esophageal deviation in the upright (A) position; moderate deviation in the prone (B) and right lateral recumbent (C) positions.

as occur in advanced mitral disease, were found.

RESULTS

Nineteen individuals showed no esophageal displacement on any of the films examined (Fig. 1). In 64 there was no displacement in the upright view, but a definite displacement was noted in one or both of the recumbent positions (Fig. 2), and in 14 there was equivocal displacement in the upright view, with greater displacement in the recumbent positions (Fig. 3).

TABLE I: ESOPHAGEAL DEVIATION IN UPRIGHT AND PRONE POSITIONS

Esophageal Deviation	Lateral Upright	Lateral Prone	Lateral Recumbent
0	83	21	19
E	14	41	33
1	3	36	41
2	0	2	7

Finally, there were 3 subjects showing a moderate deviation in the upright position, with still more pronounced displacement when recumbent (Fig. 4). In no instance was displacement in the upright greater

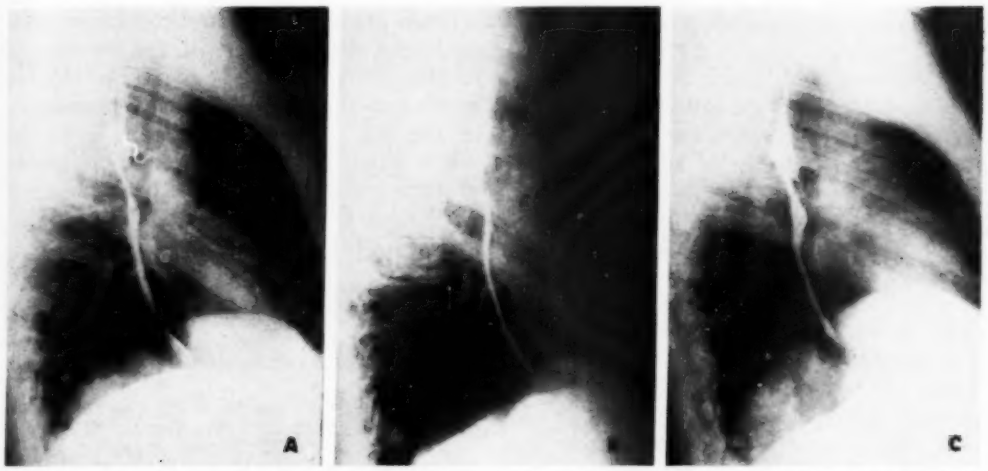

Fig. 3. Normal variation in relation of esophagus to left atrium. Equivocal esophageal deviation in upright (A), moderate deviation in prone (B), and prominent deviation in right lateral recumbent (C) position.

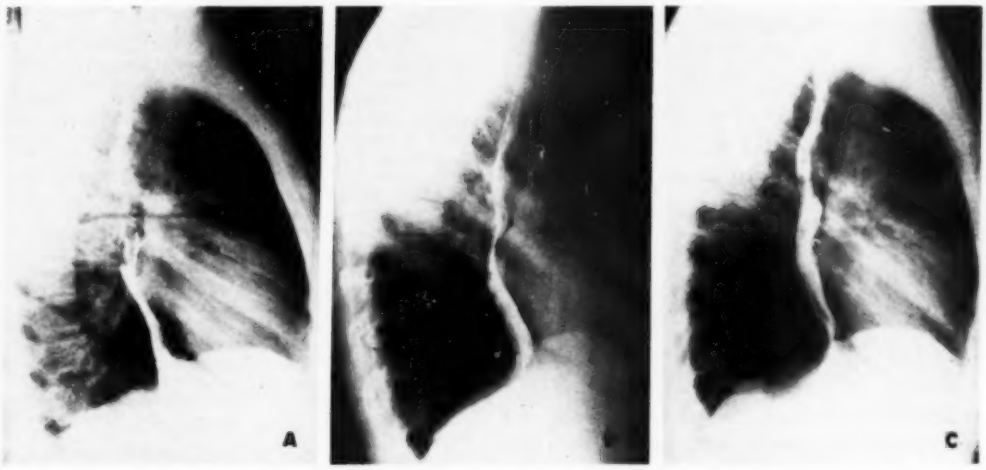

Fig. 4. Normal variation in relationship of esophagus to left atrium simulating disease. Moderate esophageal deviation in upright position (A); prominent deviation in prone (B) and lateral recumbent (C) positions.

than in the recumbent positions. The results are presented in Table I.

DISCUSSION

It has been shown by others, and we have had a similar experience, that a patient may have definite mitral disease without sufficient enlargement to displace the esophagus. It has also been found that there may be a definite displacement of the esophagus in the upright position in the normal subject.

In our series, disregarding those in whom displacement is listed as equivocal, there are still 3 apparently normal individuals showing a definite displacement of the esophagus in the upright position. There are, however, 38 who show more than equivocal displacement in the prone position and 48 with the same finding in the right lateral recumbent position. It would thus seem that localized displacement of the opacified esophagus may be a reliable, though not absolute, sign of left atrial enlargement when the patient is upright. Similar displacement in the prone and

right lateral recumbent positions is not nearly so significant. Although infants were not included in this series, it is possible that the same conditions obtain.

Another factor which has been said to affect the relationship of the left atrium with the esophagus is the phase of respiration (7). We examined three groups of 5 normal individuals each, comparing esophageal deviation in inspiration and expiration, and utilizing upright, prone, and right lateral recumbent positions. There was found to be a definite tendency to slight deviation in expiration where none was present on inspiration, and if slight deviation were present on inspiration, this was often exaggerated on expiration.

In addition to the considerations above, it should be pointed out that the degree of left atrial enlargement is not related to the severity of the mitral lesion (5). A patient with severe stenosis of the mitral valve may be seen at a time when only slight left atrial enlargement is apparent.

SUMMARY AND CONCLUSIONS

One hundred normal adults were studied in respect to the relationship of the left atrium to the barium-opacified esophagus in the upright, prone, and right lateral recumbent positions. Since only 3 subjects revealed appreciable localized esophageal deviation in the upright position, it would seem that such a change may be considered strong presumptive evidence of enlargement of the left atrium.

Since 38 individuals showed more than equivocal displacement of the esophagus in the prone position, and 48 individuals showed more than equivocal displacement in the right lateral recumbent position, it is doubtful whether any deviation, unless of extreme degree, should be considered significant if the examination is done in the horizontal position.

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SUMARIO

La Relación de la Aurícula Izquierda con el Esófago Opacificado en las Posiciones Erecta y Recostada

A 100 adultos normales, de doce a treinta años de edad, se les examinó radiográficamente con respecto a la relación de la aurícula izquierda al esófago opacificado con bario en varias posiciones.

Sólo 3 sujetos revelaron desviación localizada apreciable del esófago en la posición erguida, deduciéndose que cabe, por lo tanto, considerar esa alteración como poderosa prueba presuntiva de hipertrofia de la aurícula izquierda. En cambio, observóse desplazamiento indudable del esófago en 38 personas en la posición prona y en 48 en decúbito lateral derecho. Por esta razón, parece dudoso que deba concederse importancia a ninguna desviación esofágica, a menos que sea extremada, si se hace el examen en la posición horizontal.

La desviación esofágica fué más notable en la espiración que en la inspiración.

The Myelogram in Avulsion of the Brachial Plexus[1]

ALBERT A. RAYLE, JR., M.D., BRIT B. GAY, JR., M.D., and JASON L. MEADORS, M.D.

ALTHOUGH avulsion of the brachial plexus is a well known condition and a not uncommon entity, little attention has been paid to its radiologic features. Murphey, Hartung, and Kirklin (11) published the first case of avulsing injury of the brachial plexus in which myelography was performed. They later presented additional cases before the Clinical Congress of the American College of Surgeons (12). Only recently two other reports have appeared. Whiteleather (16) presented several cases before the American Roentgen Ray Society in 1953, and Jaeger and Whiteley (7) reported 6 cases, with myelograms in 3.

In the 6 cases to be reported here findings were obtained on myelography which are considered pathognomonic for avulsion of the brachial plexus.

INCIDENCE

The exact incidence of various types of injury to the brachial plexus is difficult to determine. The Peripheral Nerve Registry of World War II (17) contains a total of 7,050 cases. Of these, 139 involved the brachial plexus, but the type of lesion is not stated in Woodhall's summary. From 2,500 cases of peripheral nerve injury seen in the center established for such injuries at Oxford during the war, Seddon (13) describes 52 cases in which autogenous grafts were employed. Only 6 of these were of the brachial plexus.

Stevens (15) reviewed 710 cases of brachial plexus injury in the world literature up to 1932. Only 135 were verified by surgery or autopsy; 86 of these were supraclavicular, but only 32 were proved to be ruptures or avulsions.

The term avulsion is reserved for injuries with separation of nerve roots or rootlets from the spinal marrow itself. Separation elsewhere as a result of blunt or closed trauma constitutes rupture. Stevens discovered only 4 proved avulsions in the 710 cases reviewed. One of these (4) was the first case in which the seat of the lesion within the dural sac was demonstrated at operation.

MODE OF INJURY

Early writers believed that brachial plexus injury associated with shoulder dislocations, clavicular fractures, and other injuries of this region resulted from compression of the involved nerves. Gerdy in France and Horsley (8) in England are credited with expounding the traction theory of closed brachial plexus injury.

Most patients are rendered unconscious as a result of an injury producing severe brachial plexus trauma. The exact direction of the force is therefore usually conjectural. Barnes (1) points out that when the head and shoulder are forcibly separated, with the arm by the side, the greatest stress falls on the upper roots, while the lower roots are not under tension. Abduction increases tension on the lower roots.

CLINICAL FINDINGS

Traction injuries of the brachial plexus are usually divided into four main groups: Lesions of (*a*) C-5 and C-6; (*b*) C-5, C-6, and C-7; (*c*) C-8 and D-1, sometimes with C-7 also involved; (*d*) the entire plexus.

The most common injury is that of the roots of C-5 and C-6, the so-called upper or Erb type. In such an injury there is inability to abduct the arm (deltoid), to flex the arm (biceps, brachialis, supinator longus), to rotate the arm (supra- and infraspinatus), or to supinate the forearm.

[1] From the Departments of Radiology, Emory University School of Medicine and Grady Memorial Hospital, Atlanta, Ga. Presented at the Fortieth Annual Meeting of the Radiological Society of North America, Los Angeles, Calif., Dec. 5–10, 1954.

The arm is held in extension, internal rotation, pronation, and adduction. There is seldom isolated injury of C-7. Its involvement along with the above roots adds slightly to the disability. Sensory involvement in the upper type lesion is minimal. It is limited to the shoulder region unless C-3 and C-4 of the cervical plexus (10) are involved, when anesthesia extends onto the side of the neck.

In adults, the lower or Klumpke type of injury is uncommon. Patients with this lesion experience paralysis of flexion and extension of the forearm. The intrinsic hand muscles are paralyzed and the triceps is partially involved. Trophic and vasomotor symptoms are usually pronounced. If D-1 is involved high on the root, the rami to the stellate ganglion are severed and a Horner's syndrome is produced.

In cases of very severe injury, where the arm has been almost avulsed from the shoulder, all of the roots of the plexus may be injured. Naturally, the most important consideration in traction injuries of the brachial plexus is the degree of nerve stretching.

ANATOMICAL CONSIDERATIONS

Frykholm (5) and others have described the investments and stabilizing attachments of the cervical nerve roots as they emerge from the spinal cord and course to form the segmental nerves which unite to make the brachial plexus. The roots are enclosed in a dural extension, variously termed the dural, root, or axillary pouch. In the cervical region the subarachnoid space does not extend distal to this pouch, and only the pouch—never the root sleeve—is visualized in a normal myelogram of this area.

Stevens speaks of the nerve roots being "snubbed" to the transverse processes by invaginations of the prevertebral fascia. Below the clavicle, the cords of the plexus, along with the subclavian artery, are again snubbed to the clavicle, coracoid process, and the first rib by fascial investments. Stevens feels that these attachments help explain the different types of lesions resulting from stresses which come through the arm from below or occur following a blow or stress from above the clavicle.

TREATMENT

Some (3, 9, 14) advocate immediate exploration of all brachial plexus injuries, closed or open. Others (1, 2, 13) feel that immediate surgery is not warranted in traction injuries of the brachial plexus. Unless a rupture is present at a level amenable to repair, nothing is gained. Barnes found only one rupture in 10 severe plexus injuries explored.

Myelography may be of considerable value in handling these cases. If one sees changes indicating root avulsion or high rupture corresponding to the clinical level of involvement, satisfactory repair is considered impossible and no significant regeneration can be expected. In such cases, early orthopedic reconstructive surgery, as advocated by Hendry (6) and others, can be accomplished to give as useful an arm as possible.

MYELOGRAPHIC FINDINGS

As mentioned above, only the root pouch is normally filled during myelography of the cervical region. If, as a result of traction injury of severe enough degree, the root pouch is torn, contrast medium can flow distally through the intervertebral foramen. It is then contained in a diverticulum-like pocket. Murphey refers to these collections of contrast material as traumatic meningoceles, realizing that the pockets probably are not lined by meninges.

The nerve roots are more fragile than their investing membranes. Jaeger and Whiteley present 2 cases in which nerve roots were proved to have been avulsed with no myelographic changes. In other words, force was sufficient to tear the nerve fibers but not great enough to rupture their investments. In such cases, hemilaminectomy is necessary to prove the extent of the damage. When the described myelographic findings are seen, however, with appropriate clinical symptoms at the cor-

responding levels, it is unlikely that one will ever find significant nerve tissue intact.

CASE REPORTS

We have collected 6 cases showing the typical myelographic picture of avulsion or high rupture of brachial plexus nerve roots. An additional case was seen by one of us (J.L.M.) while stationed at Camp Stewart in the U. S. Army but is not available for publication at this time.

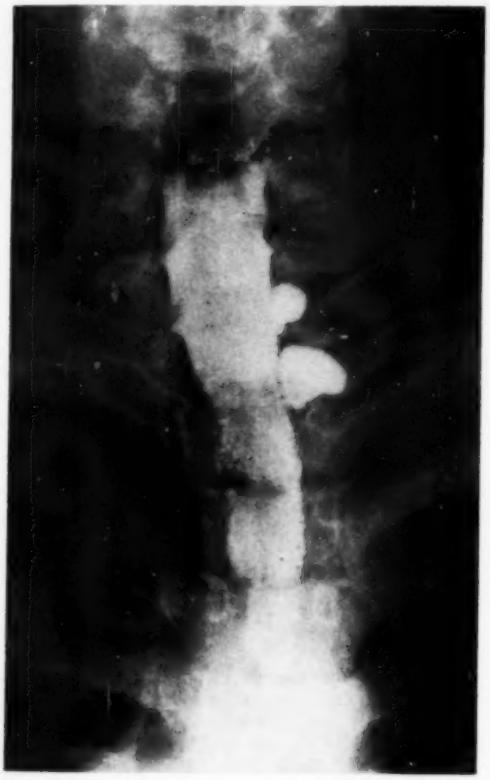

Fig. 1. Case I. Traumatic meningoceles at C-8 and D-1 levels on the left.

CASE I: A 22-year-old male was admitted to the Veterans Administration Hospital, Chamblee, Ga., on Feb. 20, 1951. Four weeks earlier, in an automobile accident, he had suffered a vertical fracture through the left scapula and greater tuberosity of the humerus. Causalgic pain in the left hand and in the distribution of the ulnar nerve developed.

Physical examination revealed paralysis of muscles innervated by the ulnar nerve and weakness of those supplied by the median nerve on the left side. Pain and touch sensations were absent over the ulna nerve distribution, with decrease in sensation over median distribution. Muscle tests indicated that this was a plexus rather than a peripheral nerve injury.

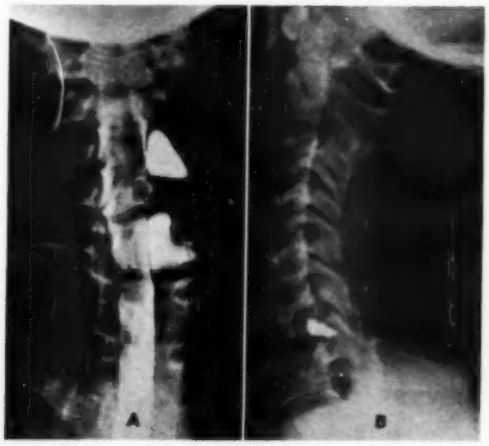

Fig. 2. Case II. A. Evidence of avulsion at level of C-6 and C-8 on the left side, and loss of normal root pouch at C-7. B. Film made twenty-four hours later, showing retention in the diverticulum-like pouches and their location in lateral projection.

Myelography (Fig. 1) on March 17, 1951, revealed large collections of extravasated contrast medium at the level of C-8 and D-1 on the left, indicating avulsion of these nerve roots.

A transthoracic sympathectomy of T-1 and T-4 was performed six days later, with some relief of the causalgia. Some improvement in function of those muscles supplied by the ulnar nerve was noted during hospital stay.

CASE II: A 21-year-old colored male was hit by a truck three years before admission to Grady Memorial Hospital and had been treated elsewhere. The exact type of injury sustained is not known. Since the injury the patient had been unable to move his left arm and had experienced anesthesia from the elbow distally.

Pertinent physical findings were confined to the left upper extremity. The left forearm and hand were flaccid. Restricted motion was present at the shoulder girdle on that side. Touch and pain were not appreciated below the elbow, and vibratory sense there was impaired. The biceps, triceps, radial, and Hoffman reflexes were absent on the left.

The clinical impression was Erb's palsy of the left upper extremity. Myelography (Fig. 2) revealed traumatic meningocele of C-6 and C-8. The root pouch for C-7 was not demonstrated on the left, indicating involvement at that level also.

CASE III: A 22-year-old colored male was admitted to Grady Memorial Hospital on Aug. 22,

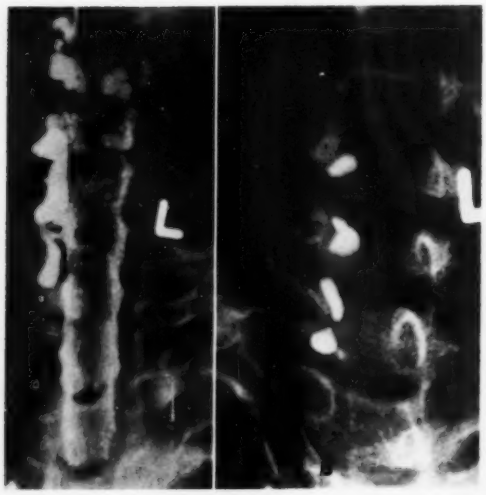

Fig. 3. Case III. A. Extravasation of contrast medium at C-5 through C-8 levels on the right. B. Twenty-four hours later, retention at sites of apparent avulsions is seen.

1949, following an automobile accident. He was unconscious and did not know the exact type of trauma received.

Physical examination of the right arm revealed loss of nerve supply to the serratus anterior, deltoid, supra- and infraspinatus, subscapularis, teres major and minor, biceps, and the coracobrachialis muscles. The nerve supply to small forearm muscles and intrinsic muscles of the hand was impaired, with motor strength in this hand one-half that in the left hand. Hypesthesia of the forearm with ulnar distribution over the hand was present. Reflexes were absent on the right.

Five days after admission slight return of flexor muscle power of the forearm was noted.

Myelography (Fig. 3) revealed traumatic meningoceles of C-5, C-6, C-7, and C-8 on the right side.

At an exploratory operation on Sept. 7, scarring of the 5th and 6th nerve roots was seen. The 7th and 8th nerve roots appeared normal, but intradural exploration was not performed. No further significant return of function occurred.

CASE IV: Following an automobile accident, Feb. 24, 1950, this patient was unconscious for a time. He was admitted to Piedmont Hospital three days later, complaining of severe pain in his neck and left shoulder, extending to the hand and fingers, and of numbness in the left arm. He had not been able to move this arm or fingers since the accident.

In a wreck one year previously he was said to have suffered dislocation of two vertebrae. He was seen elsewhere following this earlier accident, and no films were available. He had responded satisfactorily to conservative management without the use of traction or brace, so that the extent of damage is doubtful. He had continued to have occasional aching pains in the neck with residual stiffness.

Gas gangrene of the left lower leg, with extreme toxicity, complicated the hospital stay in this case, but for our purposes attention will be directed only to the left upper extremity. There was complete paralysis of the left arm, with anesthesia on its outer aspect and marked hypesthesia on the medial aspect. A fracture of the left clavicle was present. The left pupil was smaller than the right and did not react to light. There was ptosis of the left eyelid. These components of Horner's syndrome suggest involvement of the D-1 root proximal enough to sever the rami communicantes to the stellate ganglion, but this was not demonstrated myelographically. The clinical impression was avulsion of the brachial plexus.

Fig. 4. Case IV. A 1 × 4-cm. tract of Pantopaque extends along the course of the left 6th cervical nerve.

Myelography (Fig. 4) on March 17, by Dr. George Hrdlicka revealed a 1.0 × 4.0-cm. tract of Pantopaque extending out along the course of the 6th nerve root on the left side. This was assumed to be the result of avulsion at this level. The neurosurgeon, Dr. Homer Swanson, felt that exploration was not justified in view of the severe damage to at least C-6, as indicated by the myelogram.

This man showed unexpected return of feeble

biceps and deltoid function and some sensory return within six weeks of his injury.

CASE V: On May 17, 1953, a 16-year-old boy fell off a sliding board, striking his right shoulder against a concrete support. He was unconscious only a short time. Until May 31 the right arm was completely paralyzed, but on that day minimal

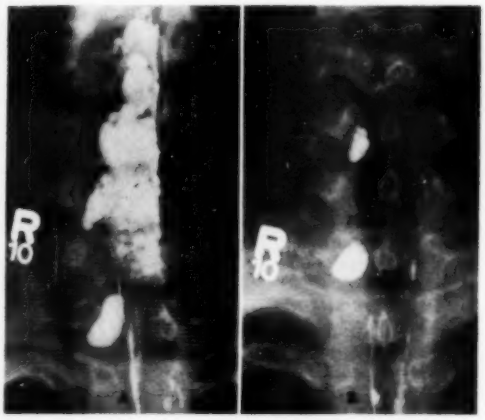

Fig. 5. Case V. A. Traumatic meningoceles at the C-6 and C-8 levels on the right. B. Appearance following immediate draining of opaque medium from cervical subarachnoid space.

flexion of the fingers was possible. Pain in this arm had interfered with sleep. Numbness in the deltoid region had been present. Some improvement in hand muscles continued but there was no return of use of the shoulder or elbow. Minimal wrist flexion had become possible.

Physical examination on July 15, when the patient was seen by Dr. Charles Dowman, revealed wasting of the muscles of the right shoulder girdle with luxation of the humeral head. Minimal rhomboid and teres motion was possible, but none of the upper arm. The flexor carpi ulnaris and palmaris longus showed fair motion. Flexion of the index finger was poor, and of the other fingers fair. Opposition of the thumb was fair but all other movements here were absent. Sense of touch was absent over the entire hand and pain perception over most of the arm. The right pupil was smaller than the left but reacted to light. Sweating was absent on the right forehead.

A cervical myelogram revealed traumatic meningoceles at the C-6 and C-8 levels. No exploration had been carried out at the time of this report.

CASE VI: A 27-year-old male suffered an injury to the right brachial plexus following a fall from a ladder on Sept. 19, 1952. Associated fractures of the right scapula and the right 1st and 2nd ribs were present. There was complete paralysis of the right upper extremity. Brachial plexus exploration elsewhere, on Jan. 5, 1953, is reported to have shown avulsed nerve roots, but the exact level or levels is not known.

When the patient was seen on March 5, 1953, examination of the right upper extremity revealed marked atrophy of the supra- and infraspinatus muscles, with paralysis. There was similar involvement of the teres major and minor. Marked atrophy of the biceps and triceps was present with paralysis, and the intrinsic muscles of the hands showed moderate atrophy. The patient had no voluntary function of any of the muscles supplying the right arm.

A complete Horner's syndrome was observed on the right. Sensory loss from the 4th cervical dermatome to and including the 1st dorsal level was present.

A cervical myelogram revealed traumatic pouch formations at C-5, C-6, and C-8 levels on the right side. These films are not now available for reproduction.

SUMMARY

Six cases are presented in which the myelographic findings are considered pathognomonic for avulsion or high rupture of cervical nerve roots. The principal feature of such a myelogram is extravasation of the contrast medium in a diverticulum-like collection beyond the level of the root pouch as a result of rupture of arachnoidal and dural investments of the nerve roots. Surgical repair in the face of such a picture is impossible, and it is doubtful if intact nerve filaments will ever be found at these levels. Demonstration of such traumatic meningoceles corresponding to the levels of clinical involvement therefore facilitates the decision as to early reconstructive procedures. Since avulsion may occur without myelographic changes, however, intradural exploration of the brachial plexus may at times be necessary for final evaluation of the extent of damage.

ACKNOWLEDGMENT: We wish to thank Doctors Homer Swanson, Charles Dowman, Ernest Smith, and Luther Clements for their kind permission to include certain of the cases in this report.

ADDENDUM

Since this article was prepared, an additional report has been published (18) dealing with the myelogram in avulsion of the brachial plexus. White and Hanelin have

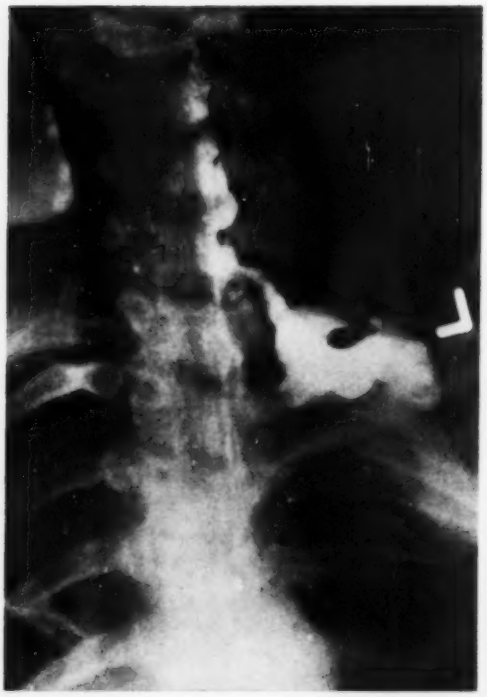

Fig. 6. Case VII. Large extravasated pocket of contrast medium at C-8 nerve level on left; smaller pocket at C-7 nerve level.

proved that the diverticulum-like pockets actually are eventually lined by meningeal tissue. This apparently proliferates in time from the torn edges of the arachnoid and dura.

We have seen 3 additional cases and because of their unusual interest feel it worthwhile to present them briefly.

CASE VII: This woman suffered one of the usual types of trauma, having been thrown from the rear seat of an automobile to the floor, striking her left shoulder and the side of her face. On admission, to the hospital her left arm was paralyzed and there was complete loss of sensibility in this arm and hand. Swelling in the left supraclavicular area was present and there were multiple abrasions of the left shoulder.

Radiographic examination revealed fracture of the left 1st and 2nd ribs and of the left mandible, as well as the left scapula. A myelogram some days later demonstrated the largest pocket of extravasated medium we have encountered, communicating with the subarachnoid space along the course of the 8th cervical nerve. Contrast material has been retained in this pouch as long as five months. A smaller extravasation occurred at the C-7 nerve level (Fig. 6).

CASE VIII: A 42-year-old male fell backward a distance of six feet some eight years earlier, striking his head and left shoulder. Use of the left arm was impaired for six weeks but gradually returned to normal. The following year the patient noted weakness in his left leg and some early bladder and rectal disturbances. Clinical findings and a plain film at that time were thought to indicate a mid-line cervical disk, and laminectomy at C-6 confirmed this suspicion. The dura was incised and not closed. The defect was bridged by Gelfoam gauze. A transverse myelitis of the lower half of the body ensued, with slow recovery.

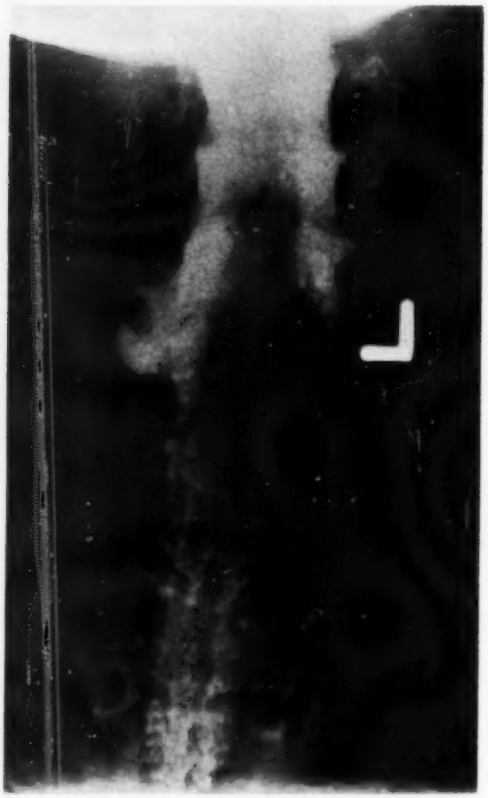

Fig. 7. Case VIII. Extravasated contrast medium at C-7 nerve level on right (post-surgical?). No clinical symptoms here.

Physical examination at the present time reveals both upper extremities to be normal as far as muscle tone and activity are concerned. A myelogram shows extravasation on the right at C-7 level. It is wondered whether this results from the original surgical procedure of eight years ago and represents a post-surgical meningocele, since no neurological findings to go along with avulsion are present (Fig. 7). (Case of Dr. Exum Walker.)

CASE IX: A 32-year-old woman received an injury to the mid-thoracic spine six years earlier. She was paralyzed from the chest down and lost control of both sphincters. After five months in a body cast, she slowly regained function of the lower extremities over a three-month period. Because of weakness in both legs and pain and swelling of the lower left leg, she was seen recently and myelography was performed. This revealed extra-arachnoidal contrast medium at the C-6–C-7 level, again without neurological evidence of involvement of the nerve root (Fig. 8).

Cases VIII and IX demonstrate the necessity of appropriate neurological findings at the levels of extravasated contrast medium before a diagnosis of avulsion can be entertained. These cases may represent the so-called arachnoidal cysts, which are said to be post-operative or, sometimes, congenital in nature.

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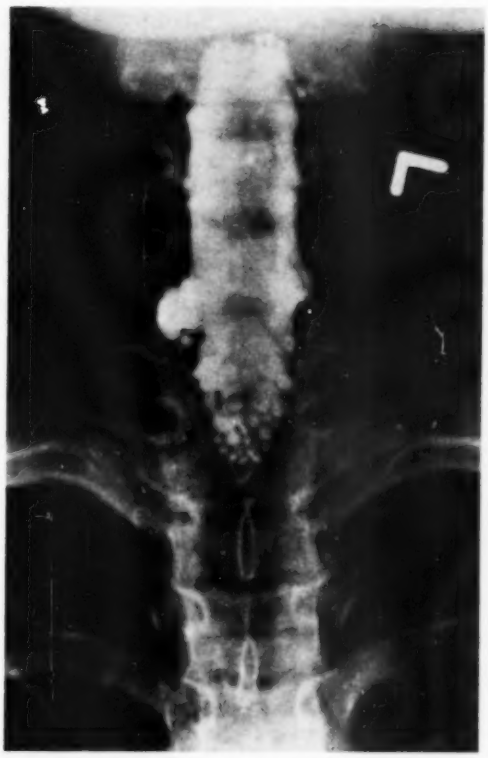

Fig. 8. Case IX. Contrast material beyond usual root pouch level, at C-7 on right. No clinical symptoms here.

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(Para el sumario en español, véase la página siguiente.)

SUMARIO

El Mielograma en la Avulsión del Plexo Braquial

Preséntanse 6 casos en que se consideran los hallazgos mielográficos como patognomónicos de avulsión o rotura alta de las raíces de los nervios cervicales. La principal característica de un mielograma de ese género consiste en la extravasación del medio de contraste a un depósito a modo de divertículo que queda más allá del nivel de la bolsa de la raíz, a consecuencia del desgarro de los revestimientos aracnoidal y dural de las raíces nerviosas. En un cuadro de tal género, la reparación quirúrgica resulta imposible y es dudoso que jamás se encuentren a tales niveles filamentos nerviosos intactos. El descubrimiento de meningoceles traumáticos de dicha índole que correspondan a los niveles de la invasión clínica facilita, por consiguiente, la decisión en cuanto a los procedimientos tempranos de reconstrucción. Sin embargo, como puede haber avulsión sin alteraciones mielográficas, a veces quizás sea necesaria la exploración intradural para la justipreciación definitiva de la extensión de la lesión.

En el apéndice, se agregan 3 casos a los anteriores.

Gastric Adenomyosis vs. Aberrant Pancreas[1]

CHRISTIAN V. CIMMINO, M.D.

THE PURPOSE OF this paper is threefold: *first*, better to acquaint the radiologist with the concept of adenomyosis in the stomach (and elsewhere in the digestive tract); *second*, to discuss the relationship between this condition and aberrant pancreas; *third*, to present what we believe to be the first case in the literature diagnosed preoperatively as aberrant pancreas radiologically but proved histologically to be adenomyosis.

Gastric adenomyosis, or adenomyoma, has received little attention in the surgical and pathologic literature (6, 7, 13, 14, 16). Grossly, this lesion consists of a nodule, usually within 5 or 6 cm. of the pyloric ring, the thickening being palpable from the exterior of the stomach, with bulging of the peritoneal surface and with intact overlying mucosa. On gross section, the small mass is found to protrude into the lumen of the stomach and the lesion is seen to be mainly submucosal, though the entire wall may be involved. Pin-point cystic cavities may be seen. The glandular structures may be differentiated from the muscular component by their lobulation and yellowish color.

Microscopically, the condition is characterized by tubular or glandular formations with wide lumina, lined with tall columnar undifferentiated epithelium not unlike biliary or pancreatic duct epithelium and sometimes even suggesting neoplasia (13). These are embedded within a smooth-muscle stroma. Two other types of epithelial structures may be found, but these are differentiated: (*a*) acini with much smaller lumina than those of the undifferentiated epithelium, more or less like normal Brunner's glands, and (*b*) acini with practically non-existent lumina, somewhat resembling normal entopic pancreatic acini. At times, even pancreatic insular tissue may be present. As observed in individual cases, the condition runs the gamut from undifferentiated columnar epithelial structures exclusively, through stages with good amounts of both undifferentiated and differentiated acinar tissue, to a cellular pattern indistinguishable from normal pancreas, the so-called aberrant pancreas, or even normal entopic Brunner's glands (7). The naming of these microscopic stages has occasioned some confusion in the past. For example, the intermediate stages of differentiation have been called either adenomyosis or adenomyoma (depending on whether or not any neoplastic tendency was discernible), or incompletely differentiated aberrant pancreas; in the last case, the term adenomyosis was reserved for those cases in which no normal pancreatic acinar tissue was present. Examples consisting solely of tissue indistinguishable from normal entopic pancreas have been universally designated aberrant or heterotopic pancreas. As far as we have been able to determine, these have not been called adenomyosis. Further, this whole group has been referred to as myoepithelial hamartoma (6), with considerable justification, in our opinion.

Clinically, patients with adenomyosis (in the sense that excludes pure aberrant pancreas) complain of upper abdominal pain with features suggesting, but not typical of, biliary tract disease or peptic ulcer. Or their pain may be indeterminate. At times, they may have pyloric obstruction. These clinical features are identical with those of the classic aberrant pancreas (2, 4, 15).

Discussion of adenomyosis, in the sense that excludes pure aberrant pancreas, is almost non-existent in radiologic literature. Moore (12) mentioned two adenomyomas in his discussion of benign tumors of the stomach, but since neither was seen on

[1] From Mary Washington Hospital, Fredericksburg, Va. Accepted for publication in June 1954.

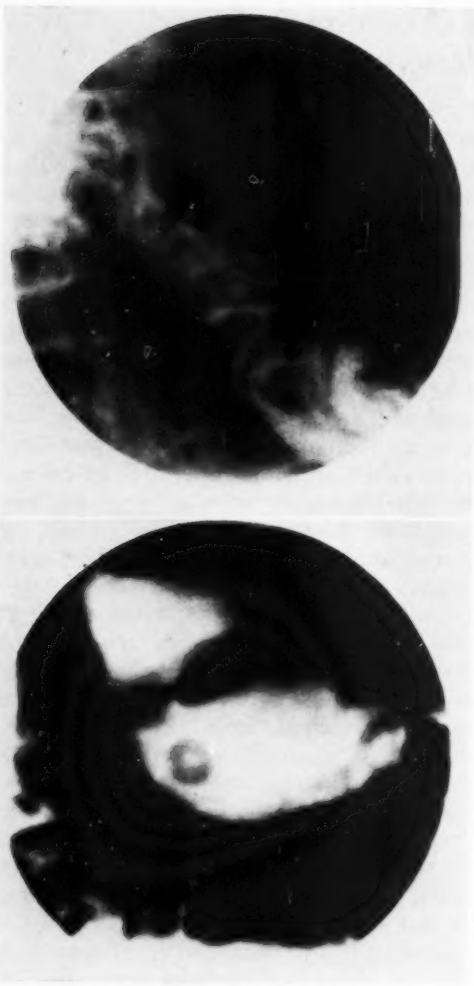

Fig. 1. Round antral lesion with central depression and intact surrounding mucosa.

roentgenologic study and since the histologic details of neither were given, these cases can be discarded. Campbell (5) reported a single case of gastric adenomyosis, which produced a bean-like filling defect in the prepylorus, diagnosed as a small benign tumor. Section revealed a nodule containing pancreatic glands in addition to larger spaces lined with duct-like epithelium within a muscular stroma. This case would probably fall in the middle of the range described above.

On the other hand, the radiology of gastric (and duodenal) aberrant pancreas is now so well known that a correct preoperative diagnosis on radiologic grounds should occasion no comment (8–11). In brief, there is a small sharply defined polypoid mass, usually within 5 or 6 cm. of the pylorus, often with a small central depression that changes in diameter from time to time, with a normal surrounding mucosa, normal peristalsis at times obliterating the lesion, and ducts seen *en profile* as they enter the central depression (9, 10). It is to be noted that the central umbilication is not a pancreatic duct but is an invagination lined with gastric mucosa (3), which has been considered almost pathognomonic.

The important conditions to be considered in differential diagnosis include the following.

1. Gastric ulcer. The marked variation in size of the central pit, the sharp peripheral clear zone representing the bulk of the lesion, so unlike the inflammatory edema of ulcer to the practiced eye, and the normal surrounding antral mucosa, make peptic ulcer unlikely.

2. Ulcerating polyp or carcinoma. There should be blood in the stools in these conditions and none with uncomplicated aberrant pancreas. The marked variation in size of the central depression would exclude polyp and carcinoma.

3. Superficial erosive gastritis engrafted upon a chronic hypertrophic gastritis (1). The normal appearance of the surrounding mucosa would make this unlikely.

4. Intramural extramucosal tumor, as leiomyoma and leiomyosarcoma. These are usually larger and more proximal in the stomach and, when ulcerated, are accompanied by gastrointestinal bleeding.

5. Lymphoma. The extreme localization makes this unlikely.

We have recently had a patient who presented all the criteria except one (visualization of the ducts) by virtue of which a diagnosis of aberrant pancreas could be made with such confidence that the surgeon was forewarned that radical surgery would probably not be necessary and a simple

excision would suffice. The initial report of the frozen section was myoma, but further sections made at the insistence of the radiology department disclosed some glandular tissue, whereupon a diagnosis of adenomyoma was given, confirmed by permanent sections. The pathologist used this term in the sense that no pancreatic tissue was present, but only undifferentiated glandular tissue and some differentiated tissue resembling Brunner's glands within a myomatous stroma.

CASE REPORT

M. J., a 61-year-old white female, had almost constant epigastric pain referred to the back, made worse by eating and interfering with sleep, for the past three months. There was little "indigestion" and occasional vomiting, no weight loss or melena. Medical treatment gave no relief. The past history was non-contributory. The only questionably pertinent finding on physical examination was tenderness in the epigastrium. The leukocyte count on admission was 5,000, with a normal differential count; hemoglobin, 14.5 gm.

Radiologic examination disclosed a round, sharply outlined lesion about 1.0 cm. in diameter in the prepyloric region, with a central umbilication of varying size, a normal surrounding mucosal pattern, and normal peristalsis (Fig. 1). *Radiologic diagnosis:* Aberrant pancreas.

Operation disclosed a nodular umbilicated lesion about 1.0 cm. in diameter in the anterior wall of the antrum 1 inch proximal to the pylorus. A fine adhesion of the serosal surface overlying the lesion to the anterior abdominal wall was noted. The lesion was excised locally (Fig. 2).

The pathologic report (Dr. G. W. Thoma, Assistant Professor of Pathology, Medical College of Virginia) was as follows: "Grossly, the specimen consists of a 3 × 1 cm. ellipse of gastric mucosa with an underlying 1-cm. nodule. Pouting from the surface is a simple duct which extends into the nodule. On section the nodule contains a few tiny yellow lobules in the center around the duct, but the rest of the tissue is pale gray and rubbery. Microscopically, the duct is lined with gastric mucosa. Around the depths are some small scattered mucus-secreting glands, resembling Brunner's glands. No pancreatic acini are found. The main bulk of the submucosal nodule is smooth muscle. *Diagnosis:* Adenomyoma of the stomach."

Recovery was uneventful.

Since the clinical picture is apparently similar in adenomyosis (in the sense that excludes aberrant pancreas) and pure aberrant pancreas, since the radiologic

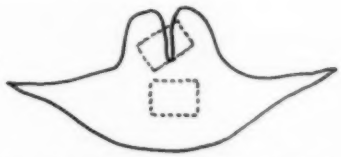

Fig. 2. Diagrammatic cross section of surgical specimen, consisting of the lesion with its central canal and a narrow border of normal stomach.

picture is probably identical, since the gross appearance may be the same (the surgical specimen from our patient was practically superimposable upon the illustration of the excised stomach in Littner's article on aberrant pancreas), since there is no sharp dividing line between the well defined examples of the two conditions (6) (thereby suggesting a common developmental origin and pathogenesis), and since the treatment is the same, we propose that the whole gamut with both extremes be called adenomyosis (generic diagnosis) and that the determination of the trends of differentiation be left to the pathologist (specific diagnosis). The term adenomyosis is etymologically correct, including those cases with glandular patterns regardless of the differentiation and number of glandular types, and regardless of the amount of smooth muscle matrix. Adoption of this designation would result in more accurate radiologic diagnosis and would make for less confusion in the literature.

SUMMARY

1. Nodules made up of varying proportions of undifferentiated and differentiated epithelial acinar structures within a smooth muscle matrix are occasionally found within the wall of the stomach and elsewhere in the alimentary system. The extreme cases in which the epithelial components consist almost exclusively of undifferentiated acinar tissue have been called adenomyosis; cases with differentiated tissue comprising pancreas alone have been designated aberrant pancreas, while those in which Brunner's glands are the sole component are known as heterotopic Brunner's glands. All intermediate grada-

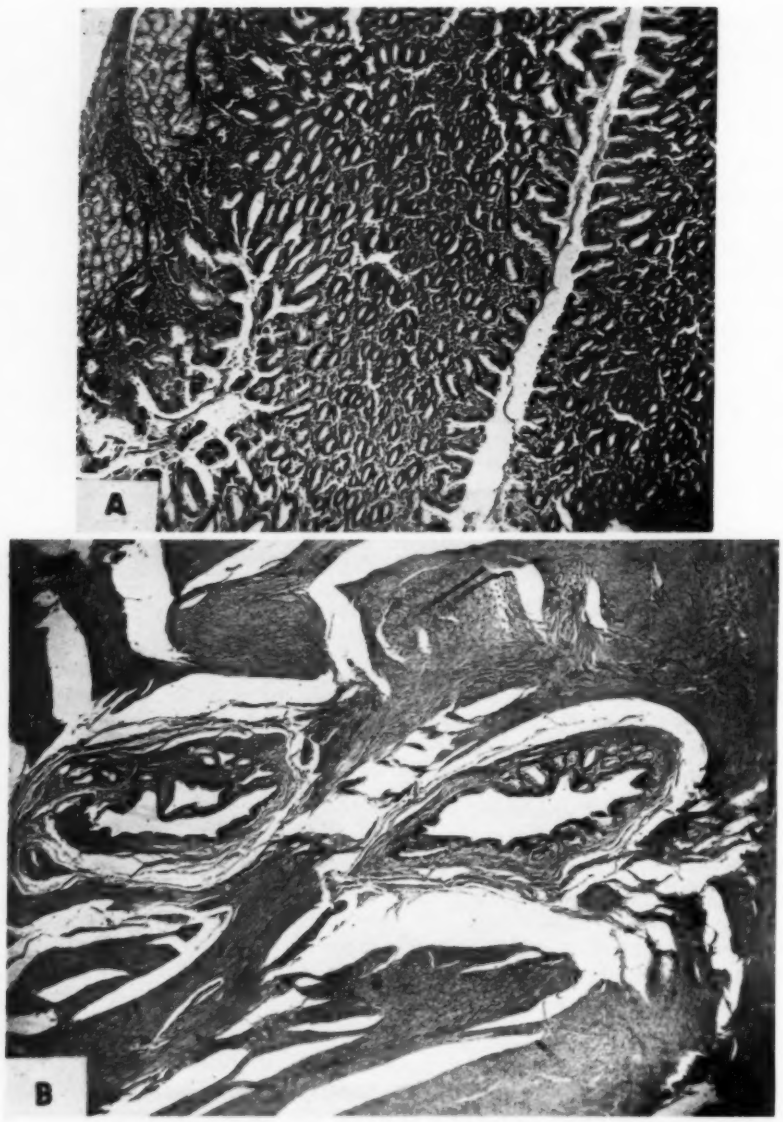

Fig. 3. A. Photomicrograph of upper box in Fig. 2, around central canal. This is to the right in the section. B. Photomicrograph of lower box in Fig. 2. See pathologist's report in text.

tions between these extremes are seen. A common developmental origin and pathogenesis are therefore suspected.

2. A case is presented in which the radiologic preoperative diagnosis was aberrant pancreas in the stomach, while the pathologic diagnosis was adenomyosis. This is the only such example that has come to our attention.

3. On the basis of study of this case, in which there were no significant clinical or radiologic differences from typical aberrant pancreas, it is proposed that the term aberrant pancreas (specific) be abandoned

radiologically in favor of adenomyosis (generic) until study of more cases establishes significant differences. The diagnosis of the specific differentiation should be left to the pathologist.

4. The familiarity of the radiologist with adenomyosis (generic) and the confidence with which he presents his diagnosis to the surgeon will prevent many unnecessary gastrectomies.

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SUMARIO

Adenomiosis Gástrica o Páncreas Aberrante

De vez en cuando descúbrense en la pared gástrica y en otras partes del aparato digestivo nódulos formados en variadas proporciones de elementos acínicos epiteliales, ya diferenciados o no, incluídos en una matriz de músculo liso. Los casos extremados en los que los componentes epiteliales constan casi exclusivamente de tejido acínico no diferenciado han sido llamados adenomiosis, aquéllos en que el tejido diferenciado comprende únicamente páncreas han sido denominados páncreas aberrante, en tanto que aquéllos en que las glándulas de Brunner son el único componente llevan el nombre de glándulas de Brunner heterotopas. Entre esos extremos obsérvase todo género de grados intermedios, por lo cual sospéchase que reconocen en su desarrollo un origen y patogenia en común.

Preséntase un caso en el que el diagnóstico preoperatorio radiológico fué páncreas aberrante en el estómago, mientras que el diagnóstico histopatológico fué adenomiosis. Este es el único ejemplo semejante de que se haya enterado el A.

A base del estudio de este caso, en el cual no hubo mayores diferencias clínicas o radiológicas del típico páncreas aberrante, propónese que se abandone el término de páncreas aberrante (específico) en pro de adenomiosis (genérico) hasta que el estudio de más casos establezca diferencias importantes. El diagnóstico de la diferenciación específica debe dejarse a cargo del patólogo.

La familiarización del radiólogo con la adenomiosis (genérico) y la seguridad con que presente su diagnóstico al cirujano impedirán muchas gastrectomías innecesarias.

Limy Ductus Choledochus[1]

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Boonton, N. J.

THE RADIOGRAPHIC demonstration of limy bile in the ductus choledochus is unusual. A survey of the literature fails to reveal any case in which this phenomenon has been conclusively observed. It should, however, be considered in the interpretation of any unusual shadows in the right upper quadrant of the abdomen.

CASE REPORT

A 40-year-old white female was admitted to the hospital Feb. 9, 1953, complaining of pain in the right epigastrium associated with slight nausea, of approximately three months duration. The pain radiated to the right shoulder and right scapular region. Two days prior to admission, the patient had noticed that the sclerae were yellow. The family history and past history were non-contributory. An appendectomy had been performed for acute appendicitis four years earlier.

Pertinent findings on physical examination were yellowness of both sclerae and tenderness over the gallbladder region. Otherwise the examination was essentially normal.

Laboratory studies were reported as follows. *Feb. 10, 1953:* Red cells 4,160,000; white cells 5,000; hemoglobin 96 per cent; icterus index 25.3; direct van den Bergh test 3.8 mg. per 100 c.c.; indirect van den Bergh test 0.4 mg. per 100 c.c.; total bilirubin 4.2 mg. per 100 c.c.; thymol turbidity 1.6; specific gravity of urine 1.005, with calcium oxalate crystals. *Feb. 12:* Icterus index 25.3. *Feb. 16:* Icterus index 24.7; coagulation time 4 minutes; bleeding time 4 minutes; prothrombin time 14 seconds; urea nitrogen 14 mg. per 100 c.c.

Roentgen Findings: A scout film of the abdomen on Feb. 10 showed multiple calcific densities in the right upper quadrant, with another shadow of like density just lateral to the upper portion of the body of the third lumbar segment. An irregular shadow was also present in the right upper quadrant, medially. The appearance was suggestive of gallstones, with the possibility of a calculus in the right upper ureter (Fig. 1).

Radiographs of the urinary tract taken Feb. 13, following the retrograde instillation of contrast medium showed the right kidney and ureter to be normal. The previously noted density was shown to be extraureteral. The tubular shadow proximal to the calcific density appeared to be a large dilated common bile duct, with a calculus at its lower portion. These findings suggested a stone in the common duct, dilatation of the duct, and stones in the gallbladder, with limy bile (Figs. 2 and 3).

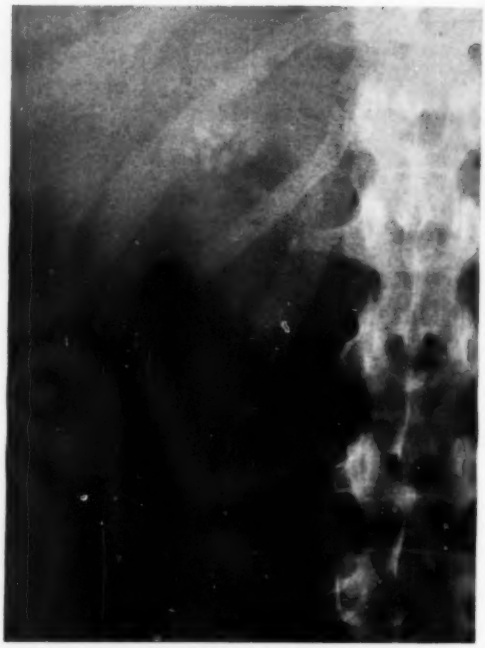

Fig. 1. Flat film of abdomen showing calculi in gallbladder region, tubular calcific shadow, and calcific density below and lateral to the transverse process of L-2 on the right side.

Operative Findings: Laparotomy through a subcostal incision showed adhesions between the duodenum and the gallbladder and between the duodenum and the cystic duct. The common duct was exposed, and a sample of its contents was found to be thick and milky in appearance. Palpation revealed a stone in the region of the ampulla of Vater. The common duct was opened, and the stone pushed through the ampulla into the duodenum. A small catheter was introduced into the common duct proximally as well as into the hepatic ducts, and irrigation revealed a thick, yellow, sludgy, creamy type of bile.

Follow-Up: Jaundice subsided, the patient improved clinically, and on Feb. 23, four days after operation, the icterus index was 9.1. Radiographs taken on Feb. 26, following the introduction of Lipiodol through the T-tube which had been previously inserted in the bile duct, showed the contrast

[1] Accepted for publication in June 1954.

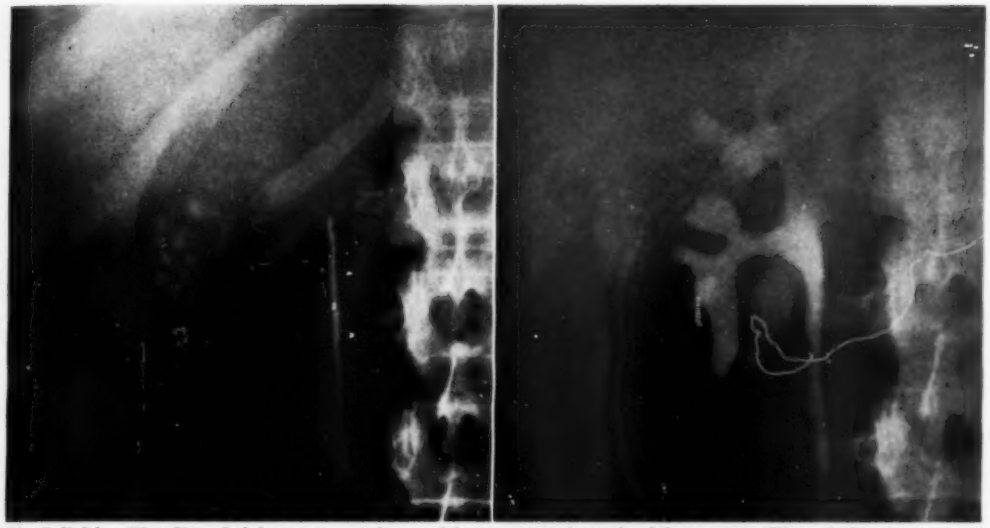

Fig. 2 (left). Flat film of right upper quadrant with opaque catheter in right ureter. The tubular shadow and calcification at lower portion are seen to be extra-ureteral.

Fig. 3 (right). Retrograde pyelogram showing relationship of kidney, tubular shadow, and calculi.

medium to enter the duodenum with no evidence of delay or obstruction. No calculi were noted. The biliary tree was outlined and appeared normal.

Pathological Report: The material for pathologic study included the gallbladder and approximately 3 c.c. of clear olive-colored bile. Floating at the bottom of the container holding the bile were several fragments of an amorphous, yellow-green, soft substance, forming a total volume with a diameter of 0.5 cm. The gallbladder measured 11 cm. in length and 3 cm. in diameter. The serosa was smooth and glistening, the wall pliable and 0.2 cm. in thickness. The mucosa was smooth and velvety, markedly congested and pink. The lumen contained 10 c.c. of bloody bile, in which were eight small, irregular, bright yellow calculi and amorphous dark yellow sludge.

Microscopic sections revealed a well preserved mucosal layer with a decreased number of papillary projections. The musculature was increased in thickness. A few lymphocytes and a rare eosinophil were seen in the interstitial tissue. The serosal coat was not thickened; the subserosal layer contained lymphocytes and a few plasma cells.

The calculi were composed of calcium bilirubinate and cholesterol crystals, as was the sludge.

Diagnosis: Chronic cholecystitis with cholelithiasis (Fig. 4).

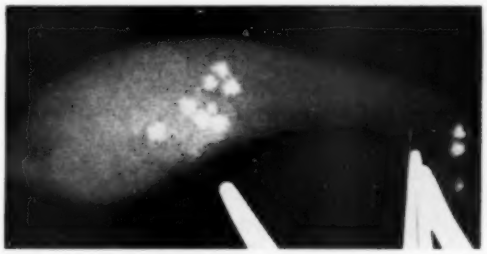

Fig. 4. Roentgenogram of the excised gallbladder, showing calculi and opaque gallbladder contents.

DISCUSSION

Churchman, in 1911, apparently was the first to report the presence of limy bile in the gallbladder. Volkmann coined the term *Kalkmilchgalle* (milk of calcium bile), but Knutsson, in 1933, was the first to suggest the term "limy bile" as probably more appropriate. Whereas jaundice is rare in cases of limy bile of the gallbladder, the case reported here showed jaundice as a presenting symptom. Bergeret, Caroli, and Lagarenne, in 1947, reported a case which presumably was one of calcareous bile in the ductus choledochus, but this was not verified by operation. In their case, a shadow resembling the ductus choledochus was noted but subsequently disappeared, following the administration of olive oil.

On pathologic study, the gallbladder is usually found to be contracted, but on occasion it may be distended. The cal-

careous matter may occur as a milky fluid, paste, or seromucinous exudate with sand or gritty material. The color varies from white to greenish yellow to brown, depending on the amount of bile present. Calculi are usually found in cases with limy bile, and occlusion of the cystic duct almost invariably occurs. In the case reported here, there was a stone in the ampulla of Vater, which had the same effect, causing retention of the limy bile, and thus permitting the ductus to be outlined. Ductus choledochus may be confused with a thickened fold of the mucosa of the colon. Presumably, a ductus only scantily filled with limy bile can easily be overlooked by the radiologist.

The formation of limy bile is basically part of stone formation. The greater portion of bile calcium is secreted by the liver, and the normal gallbladder acts to remove calcium from the bile. Johnston, Ravdin, Austin, and Morrison, from their studies on dogs, concluded that calcium is not secreted into the normal gallbladder, but that a small amount may be secreted when the gallbladder has been damaged. Phemister, Rewbridge, and Rudisill, however, found evidence that calcium carbonate is secreted by the gallbladder wall and is not derived from the bile. When a block of the cystic duct occurs in association with low-grade chronic inflammation of the wall, there is precipitation of calcium carbonate.

SUMMARY

1. Á case is reported in which limy bile was demonstrated roentgenologically in the ductus choledochus.

2. The etiology of the formation of limy bile is discussed.

3. In the presence of unexplained shadows in the right upper quadrant of the abdomen the possibility of limy bile in the ductus choledochus should be considered if clinical evidence suggests some involvement of the gallbladder.

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SUMARIO

Colédoco Calcáreo

Descríbese un caso en el que se descubrió radiológicamente bilis calcárea (también llamada bilis de "leche de calcio"), comprobándose esto al operar. La formación de bilis calcárea se cree que es fundamentalmente parte de la litiasis. En esos casos, suelen observarse cálculos y casi siempre sobreviene oclusión del conducto cístico. En el caso actual, un cálculo de la papila de Santorini era la causa de la retención de la bilis en el colédoco, permitiendo así observarla en la radiografía. La operación ejecutada fué un exito.

Cuando se noten sombras inexplicadas en el hipocondrio derecho, debe tomarse en cuenta la posibilidad de bilis calcárea en el colédoco, si los signos clínicos sugieren alguna invasión de la vesícula biliar

Ectopic Gastric Mucosa in a Congenital Small Bowel Diverticulum

Roentgen Demonstration and Report of a Case[1]

WARREN L. KUMP, M.D., JOSEPH JORGENS, M.D., and LEO G. RIGLER, M.D.

CONGENITAL small bowel diverticula occur in about 2 per cent of adults. Most of these are Meckel's diverticula. The remainder are duplications of the bowel of different embryologic origin. Because of confusion in diagnosis, the relative incidence of the two types is not completely established.

Meckel's diverticulum consists of a persisting portion of the yolk sac or vitelline duct. It occurs, therefore, on the antimesenteric side of the bowel at the junction of the cephalic and caudal limbs of the primitive gut loop. This site in the adult is 20 to 100 cm. above the ileocecal valve. The tip of the diverticulum may be joined to the umbilicus by a fibrous cord representing the remainder of the vitelline duct.

Bowel duplication is of disputed, and perhaps variable, embryologic origin, but is unrelated to the vitelline duct. Its site is inconstant, but it is most frequent in the ileum and almost always on the mesenteric side. It may be tubular or cystic and may or may not communicate with the normal bowel lumen. In duplication which communicates with the normal bowel, the anatomical similarity to Meckel's diverticulum is such that there is frequent confusion with the latter. This explains the large number of reported cases of "unusual" and "atypical" Meckel's diverticula found far from the usual site in the ileum, and sometimes on the mesenteric side of the bowel (1). Duplication is also known variously as enterocyst, giant diverticulum, inclusion cyst, and ileum duplex (2).

Both Meckel's diverticulum and bowel duplication vary widely in size and shape. In both, all four layers of the bowel are present. They are thus distinguished from acquired diverticula, including mucosal herniations and walled-off bowel perforations, which contain no muscular coat. Either Meckel's diverticulum or bowel duplication may contain ectopic gastric or pancreatic tissue. The stimulus for the development of this ectopic tissue is not well understood, but it appears to be active in all types of congenital bowel diverticula (3).

Roentgenologic distinction between the two types of congenital diverticula is difficult, and in many cases impossible. Since the symptoms, prognosis, and complications are often similar, and largely unpredictable, it seems desirable for purposes of roentgen reporting to group both under the simple heading of congenital small bowel diverticula.

Congenital diverticula of the small bowel are seldom demonstrated roentgenologically, presumably because of their generally small size and their proximity to the bowel. Furthermore, they are often filled with non-opaque intestinal contents which prevent the entrance of barium (4). Nevertheless, their radiographic demonstration is now occurring more frequently. This may be due to increased awareness of these anomalies on the part of radiologists, and also to the increasing frequency of small bowel examinations.

Because of their greater incidence, Meckel's diverticula have predominated among the reported cases of radiographically demonstrated congenital diverticula. Some of the roentgen signs which have been noted are:

1. The finding of a collection of barium in the mid or lower ileal area, which fails to conform to the usual pattern of

[1] From the Department of Radiology of the University of Minnesota Medical School and the Veterans Administration Hospital, Minneapolis, Minn. Accepted for publication in July 1954.

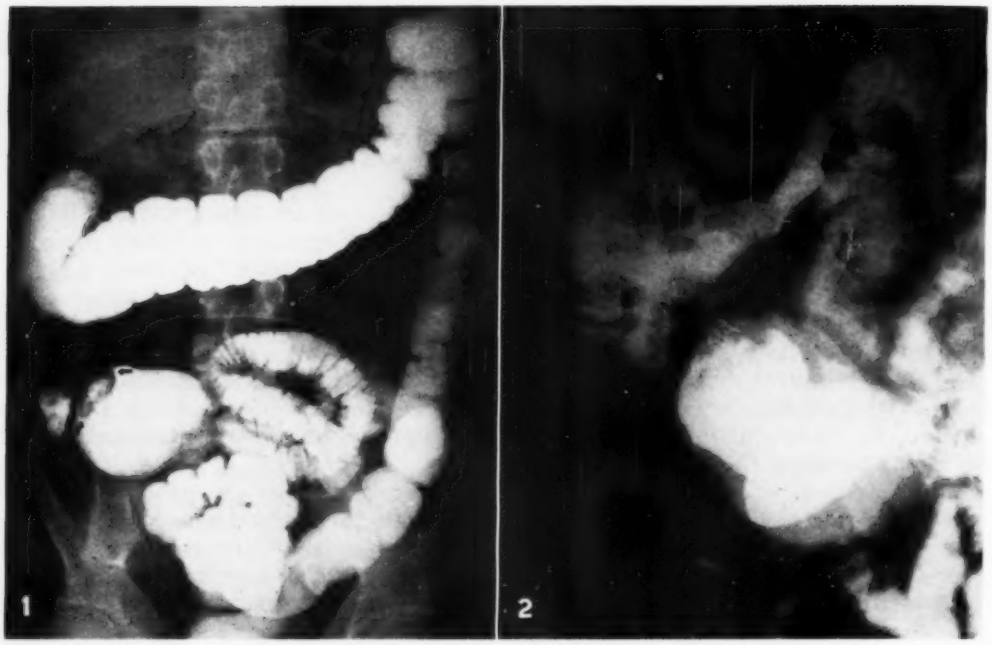

Fig. 1. Ileal diverticulum filled during barium enema. Filling was immediate and painless. Arrows indicate a flat filling defect believed to represent the thin septum found between the diverticulum and the bowel.
Fig. 2. Peristalsis demonstrated by three superimposed exposures taken at five-second intervals. Presence of a functional muscular coat indicates the congenital origin of the diverticulum.

the small bowel or persists after the small bowel is empty (4).

2. A half-moon or finger-like projection arising from the ileum (5). The length of the projection is usually 3 to 5 cm., but wide variations exist. The site on the ileum also varies greatly, the average being about 50 cm. from the ileocecal valve (6).

3. Peristalsis in the diverticulum, indicating the presence of a functional muscular wall and therefore ruling out acquired diverticula. The importance of this sign was pointed out by Lewitan (1953), who emphasized the value of fluoroscopy in cases of suspected congenital diverticula (7).

4. Orientation such that the diverticulum points toward the umbilicus in lateral as well as frontal views (8). This occasional finding appears to be due to the persistence of a fibrous cord joining the diverticulum to the umbilicus.

5. Demonstration of an air bubble which does not conform to the bowel pattern. This finding suggests the diagnosis and should be followed by attempts at confirmation by barium studies (9).

The following case is of interest not only because several of the above findings were present, but also because it was felt that the resemblance of the mucosal pattern of the diverticulum to that of the stomach was such that a preoperative diagnosis of ectopic gastric mucosa could be made. Although the presence of such tissue has been predicted successfully in previously reported cases, the evidence was largely clinical or the diagnosis was based on the presence of a filling defect assumed to represent an islet of ectopic tissue within the diverticulum. Winkelstein demonstrated a peptic ulcer crater within a Meckel's diverticulum (5). A review of the literature indicates that the following case is the first reported in which a gastric rugal pattern was recognized preoperatively and verified at surgery.

CASE REPORT

N. J. S., a 28-year-old serviceman, gave a history of the onset of diarrhea and dull right lower quadrant pain three months prior to his admission to the hospital. The diarrhea subsided after one week, but mild pain persisted intermittently until shortly before admission. It was not associated with nausea or vomiting. Annoyed by the dull aching, the patient reported to his unit dispensary and was referred to the out-patient department, where a barium enema study revealed a small bowel diverticulum which was filled with reflux barium from the ileocecal valve (Fig. 1). He was admitted to the hospital for further investigation and treatment.

On admission, the patient was asymptomatic. Physical examination was negative. The family history was non-contributory. Urinalysis and blood counts were normal. The stools showed no gross or occult blood.

An upper gastrointestinal examination revealed a normal stomach. In the small bowel examination there was noted a regular pear-shaped diverticulum of the ileum near the ileocecal valve. Peristalsis in the diverticulum was active (Fig. 2), beginning at its tip and proceeding to its neck, where it joined with the ileum. On the three-hour film there was noted a mucosal pattern with a striking resemblance to that of the stomach (Fig. 3). The longitudinal mucosal folds were smooth and regularly spaced, resembling most closely the body of the stomach. There was no evidence of either atrophic or hypertrophic "gastritis" or of a peptic ulcer crater. The diverticulum was easily visualized on subsequent films up to ten hours after the ingestion of barium, but the gastric mucosal pattern could not be demonstrated after the three-hour film, even by use of pressure and palpation.

A repeat barium enema was done a few days later, and a reflux of barium into the ileum again filled the diverticulum but failed to demonstrate the gastric mucosal pattern.

On Dec. 30, 1953, the diverticulum was exposed at surgery. It was found to be 2.5 cm. from the ileocecal valve, arising near the mesenteric side of the ileum and enclosed between the layers of the mesentery. A thin septum separated its lumen from that of the bowel. A defect in the septum, 2 cm. in diameter, allowed communication with the bowel. A simple excision of the diverticulum was possible without interference with the blood supply of the ileum. An appendectomy was also done, although the appendix was normal. The postoperative course was uneventful. Two weeks following surgery the patient was asymptomatic.

Gross examination of the surgical specimen revealed a wrinkled mucosal surface resembling that of the stomach. The microscopic appearance was that of gastric mucosa with areas resembling both antrum and body. The muscularis mucosae was well developed and may have contributed to the prominence of the rugae. There were areas of round-cell infiltration and numerous large lymphoid follicles in the sections, giving an appearance of mild gastritis. No ulcer was present. The pathologic diagnosis was small bowel duplication with ectopic gastric mucosa.

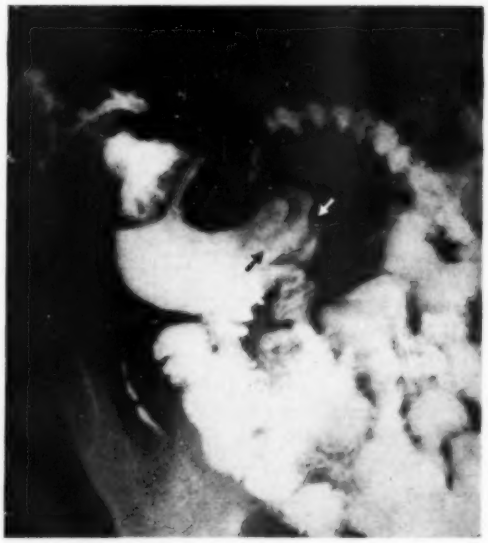

Fig. 3. Rugal pattern of gastric mucosa within the diverticulum.

DISCUSSION

The appearance of a gastric rugal pattern in the diverticulum in this case was considered an indication for surgical intervention, even in the absence of serious symptoms. The importance attributed to the mucosal pattern was based on the knowledge that Meckel's diverticula with gastric-type mucosa are more commonly responsible for intra-abdominal complications than are those with mucosa resembling that of the small intestine. In a series of 103 Meckel's diverticula diagnosed by various means, Jay *et al.* (10) found that 62 per cent of those excised in their acute and chronic cases contained a gastric type of mucosa, while the incidence of gastric mucosa among the diverticula which were removed incidentally at operation for other conditions was 22 per cent. These writers emphasized, therefore, the potentially morbid significance of such ectopic gastric mucosa. They expressed the belief that all Meckel's diver-

ticula should be removed on discovery because of the 20 per cent incidence of gastric mucosa among those found incidentally.

Hemorrhage due to peptic activity is the most common complication of Meckel's diverticulum (11). Other complications ascribable to ectopic gastric mucosa are peptic ulcer, perforation, scarring with contracture leading to intestinal obstruction, and even malignant change arising in the mucosa (12). The harmful effect of the peptic activity is due to its synchronous occurrence with that of the stomach. At such time the adjacent small bowel is not protected by the buffering action of food and intestinal juices as is the duodenum. The result is frequent erosion and ulceration of the bowel near its junction with the gastric-type mucosa.

Unfortunately, gastric mucosa cannot be visualized roentgenologically in most small bowel diverticula, even when present. In the case reported above the mucosal pattern was demonstrated only as the diverticulum was beginning to fill; subsequently it could not be seen even with the application of pressure or with palpation. Moreover, the mucosa is often localized to small patches, rather than distributed generally as in this case. The apex of the diverticulum is the most consistent site of these patches (3, 13). The gastric tissue, if visualized at all, might in many cases appear as a filling defect in the tip of the diverticulum, and be confused with intestinal contents, polypoid intestinal mucosa, or blood clot. A case presenting this problem was reported by Grossman *et al.* (11).

Attention to the mucosal pattern of radiographically demonstrated diverticula appears warranted because of the prognostic significance of gastric mucosa and because the excision of all asymptomatic congenital diverticula is not a generally accepted surgical practice.

SUMMARY

1. Distinction by means of x-ray study between Meckel's diverticulum and duplication of the bowel is difficult and often impossible. It is suggested that, for purposes of x-ray reporting, such structures might well be designated simply as "congenital small bowel diverticula."

2. Congenital diverticula may be distinguished from the acquired type by the presence of a functional muscular coat. Preoperatively the distinction is sometimes possible through the demonstration of peristalsis at fluoroscopy.

3. The roentgen appearance of previously reported Meckel's diverticula is discussed.

4. A case is reported in which ectopic gastric mucosa within a congenital small bowel diverticulum was demonstrated radiographically. A review of the literature fails to reveal previous reports of such an occurrence.

5. The frequency of complications in congenital diverticula with ectopic gastric mucosa is noted.

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SUMARIO

Mucosa Gástrica Ectópica en Divertículo Congénito del Intestino Delgado. Descubrimiento con los Rayos X y Presentación de un Caso

La diferenciación por medio del estudio roentgenológico entre el divertículo de Meckel y la duplicación del intestino resulta difícil y a menudo imposible. Sugiérese que, para los fines de la descripción roentgenológica, se designe a esos tejidos meramente como "divertículos congénitos del intestino delgado."

Los divertículos congénitos pueden distinguirse de los adquiridos por la presencia de una capa muscular funcionante. Preoperatoriamente, la distinción resulta a veces posible mediante el descubrimiento de peristaltismo con la roentgenoscopia.

Los divertículos congénitos del intestino delgado a menudo no son observables roentgenográficamente. La mayor parte de los casos descubiertos en esa forma han sido de divertículos de Meckel, citándose aquí los hallazgos roentgenológicos mencionados por varios observadores.

Preséntase un caso en que se notaron varios de dichos hallazgos y que reviste además interés por haber en el divertículo mucosa gástrica ectópica. Este caso parece ser el primero descrito en que se reconociera preoperatoriamente y se confirmara después un patrón de arrugas gástricas en un divertículo del intestino delgado.

La frecuencia de las complicaciones en esos casos hace que posea importancia la atención prestada al patrón de mucosa en los divertículos descubiertos radiográficamente.

Gastroduodenal Intussusception[1]

HOWARD MAUTHE, Ph.D., M.D.,[2] and GEORGE ZWICKY, M.D.[3]

In 1951, Marshak, Lifsay, and Brahms (1) reported a case of intussusception of the stomach which was thought on roentgen examination to represent a tumor of the second portion of the duodenum. The excellent bibliography assembled by these authors reveals that very few cases of gastroduodenal intussusception have been reported. What is even more surprising is the fact that in only 2 of the reported cases has the diagnosis been made prior to surgical exploration. These 2 cases were published by Lönnerblad in 1933 (2) and the characteristic roentgen signs were described by him. The appearance of the intussusception into the duodenum is practically identical with that produced by an ileocecal intussusception, and the concomitant shortening and distortion of the distal end of the stomach should make the condition easily recognizable roentgenologically if the possibility of its presence is considered.

In children, ileocecal intussusception usually occurs without any intrinsic abnormality in the bowel. In adults, however, such intussusception is most commonly the result of some type of neoplasm in the bowel wall which, propelled by peristaltic motion, becomes the leading portion of the intussusceptum, invaginating the bowel as it proceeds. The same mechanism apparently obtains in gastroduodenal intussusception, since in all of the reported cases there has been a neoplasm, usually on the posterior wall of the stomach, which is propelled by gastric peristalsis through the pylorus and into the duodenum, dragging a portion of the stomach wall behind it. This produces on the roentgenogram a large, well circumscribed filling defect in the duodenum surrounded by streaks of contrast material trapped in the folds of the duodenal mucosa. These streaks tend to arrange themselves in a circular or "bedspring" pattern almost identical with those seen about an ileocecal intussusception. While this appearance may be produced by a large polypoid lesion originating in the duodenum, in gastroduodenal intussusception it is associated with considerable shortening and distortion of the distal end of the stomach, thus making differentiation of these two conditions possible.

It is the purpose of this communication to report 2 additional cases of gastroduodenal intussusception, both of which were correctly diagnosed preoperatively by x-ray examination.

Case I: A 54-year-old white male entered St. Agnes Hospital on April 1, 1953, complaining of epigastric pain immediately after eating, which he had experienced for several months. There was a recent history of numerous tarry stools and weakness. Physical examination was essentially negative except for slight tenderness in the epigastrium. No masses were palpable in the abdomen.

X-ray examination of the upper gastrointestinal tract on admission showed the distal end of the stomach to be markedly distorted, the barium passing with great difficulty out of the fundus even in the upright posture. A large mass was seen, extending down through the second portion of the duodenum, surrounded by coil-shaped streaks of barium (Fig. 1).

It was thought at first that we were dealing with a tumor arising in the duodenum. After considerable reflection, however, the similarity of the findings to those in ileocecal intussusception was recognized. It was therefore postulated that the patient had a neoplasm of the stomach which was bleeding and that this neoplasm had intussuscepted into the duodenum. Meanwhile supportive therapy was given, with considerable relief of pain.

The upper gastrointestinal tract was re-examined on April 7, because it was felt that the subsidence of pain might possibly indicate spontaneous reduction of the intussusception. There was, however, no significant change in the appearance of the stomach and duodenum (Fig. 2).

[1] From St. Agnes Hospital, Fond du Lac, Wisc., and V. A. Hospital, Hines, Ill. Accepted for publication in June 1954.

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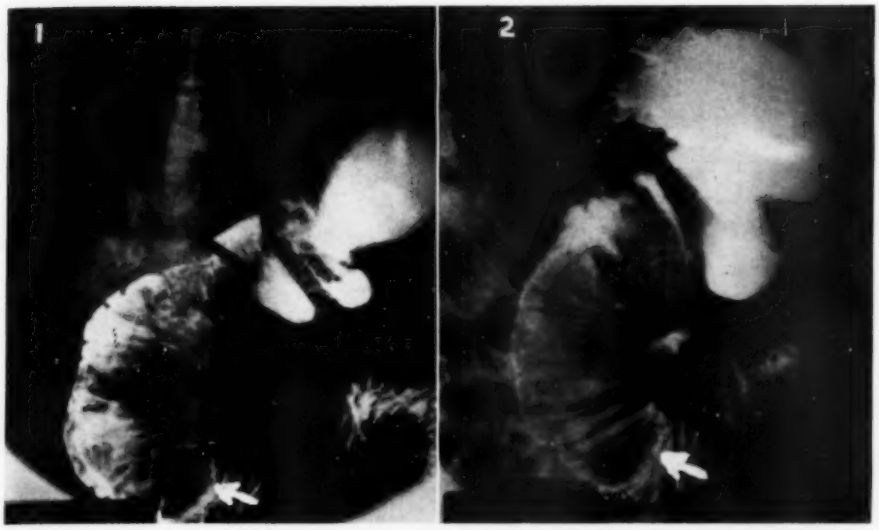

Fig. 1. Case I: First examination on April 1, 1953. Note the large mass in the second portion of the duodenum, with marked shortening and distortion of the distal part of the stomach.
Fig. 2. Case I: Second examination on April 7, 1953. There has been no significant change in the period of six days. This film shows the coil-shaped streaks of barium particularly well.

Surgical exploration was carried out on April 8. The duodenum was found to be dilated, and within its lumen a large smooth mass was felt, which moved rather freely back and forth, but could not be pushed up through the pylorus into the stomach. The surgeon accordingly expressed the mass as far toward the pylorus as possible and transected the duodenum at about the junction of the first and second portions. A second transection was done just above the pylorus, at a point which actually proved to be in the mid-portion of the body of the stomach. A direct anastomosis between the stomach and the duodenum was then performed.

Figure 3 shows the operative specimen with the clamps removed. Protruding from the cut end of the dilated duodenum is a tumor with a partially necrotic surface and a portion of gastric mucosa which has been dragged down into the duodenum with it. When the specimen was opened longitudinally, the normal anatomical relationships were restored, and a kidney-shaped tumor measuring 3.5 × 10 cm. was found in the stomach, 9 cm. from the pylorus. This tumor was entirely surrounded and partially covered by gastric mucosa; the portion not covered by mucosa was necrotic. The tumor appeared to originate from the submucosa. Microscopically it was composed of fat tissues containing a minimum amount of fibrosis. The pathologic diagnosis was lipoma of the stomach.

CASE II: A 66-year-old white male entered the Veterans Administration Hospital, Hines, Ill., on July 22, 1953, with a history of malaise and weakness for the previous three months. He had consulted a physician in April 1953, at which time a study of the upper gastrointestinal tract revealed a polypoid lesion in the distal portion of the stomach. Examination on July 27, 1953, showed a polypoid mass in the second portion of the duodenum, with shortening of the distal end of the stomach (Fig. 4). A funnel-shaped central streak of barium was seen projecting from the stomach into the duodenum, surrounded by coiled streaks of barium. Because the films on Case I had previously been seen, these findings were readily recognized as indicating gastroduodenal intussusception.

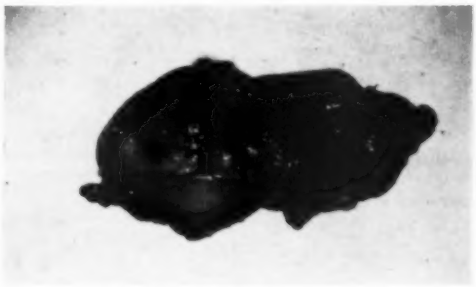

Fig. 3. Case I: Operative specimen with clamps removed. Note the tumor with necrotic surface protruding from the cut end of the dilated duodenum. Some of the gastric mucosa surrounding the tumor is also seen.

Re-examination of the upper gastrointestinal tract was done on July 29, and on this occasion it was found that the intussusception had reduced

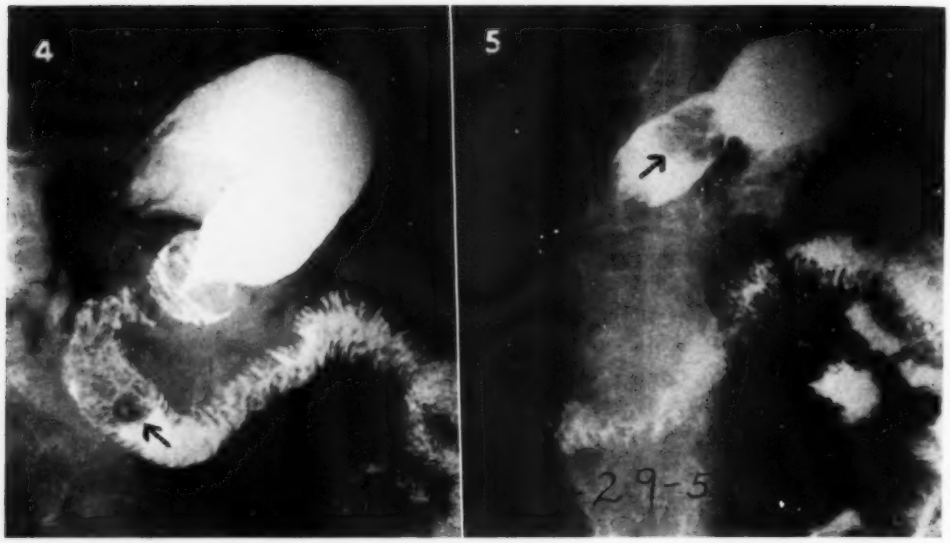

Fig. 4. Case II: First examination on July 27, 1953. The distortion of the distal portion of the stomach is not as marked as in Case I, but a funnel-shaped deformity, the mass in the second portion of the duodenum, and the coil-shaped streaks of barium are well demonstrated.

Fig. 5. Case II: Second examination on July 29, 1953. The gastroduodenal intussusception has reduced itself and the polypoid lesion is now seen in the gastric antrum.

itself and a polypoid mass was seen lying in the distal end of the stomach (Fig. 5). A diagnosis of polypoid neoplasm in the distal end of the stomach with intermittent gastric intussusception was made.

On Aug. 4, 1953, the tumor in the stomach was removed. The pathologic diagnosis was anaplastic muco-adenocarcinoma.

COMMENT

The observation of 2 cases of gastroduodenal intussusception within a period of four months is an extraordinary coincidence. It may be, however, that the condition is not quite as rare as one might be led to believe by published reports, or that it is not being recognized when it is seen on roentgen examination. Case I is of special interest because the lesion causing the intussusception was a gastric lipoma, a tumor which is of rare occurrence. Palmer in 1951 could find only 103 cases of fatty tumors of the stomach reported in the literature (3).

SUMMARY

Two cases of gastroduodenal intussusception are reported. In each instance the diagnosis was made by roentgen examination prior to surgical intervention. In one case the intussusception was due to a large gastric lipoma, in the other to a polypoid adenocarcinoma.

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SUMARIO

Invaginación Gastroduodenal

Preséntanse 2 casos de invaginación gastroduodenal. En ambos, se hizo el diagnóstico por el examen roentgenológico antes de la intervención cruenta. En un caso, se debía la intususcepción a un gran lipoma gástrico y en el otro a un adenocarcinoma polipoideo.

Rige en estos casos aparentemente el mismo mecanismo que en la invaginación ileocecal en los adultos. Una neoplasia, por lo general de la pared posterior del estómago, es impulsada por el peristaltismo a través del píloro al duodeno, arrastrando consigo una porción de la pared gástrica. Esto produce en la radiografía un gran nicho bien circunscrito, rodeado de estrías de substancia de contraste atrapada en los pliegues de la mucosa duodenal. Esas estrías tienden a desplegarse en un patrón circular o "de muelle." Suele haber además acortamiento y deformación del extremo distal del estómago.

A Spectrometric Method for the Study of Radon Partition in Radium-Burdened Animals[1]

P. F. GUSTAFSON, M.S., and L. D. MARINELLI, M.A.

THE RADIUM burden of living mammals is usually obtained by measuring both the gamma-ray activity of the Ra(B + C) retained in the body and the time rate at which radon is lost in the breath. Whereas the first can be done consistently with satisfactory accuracy (1), relevance of the latter measurement is predicted on the assumption that, at the time of sampling, the rate of radon exhalation equals the rate of radon release from the radium deposits in the body. Since the radon exhalation rate of a single subject may vary over short periods of time (2), experimental results are beset by annoying uncertainties, which can be minimized at best by repeated sampling in the case of man and can be effectively eliminated only by periodic sacrifice and Ra assay when dealing with laboratory animals.

The method to be discussed here consists in comparing with a scintillation spectrometer the relative intensities of the Ra^{226} and RaB gamma rays emitted by an animal to those of suitably prepared standards, and in evaluating by these means the fraction of radon retained. It should be realized at the outset that whereas RaB emits gamma rays of 240, 295 and 350 kev in numbers comparable to its rate of disintegration, Ra^{226} emits instead a 50 per cent internally converted gamma ray of 186 kev in only approximately 6 per cent of its disintegrations. Despite this small probability of emission, the gamma ray in question is easily detected by scintillation spectrometers in Ra sources where radon is present in amounts lower than 50 per cent equilibrium, as is true of radium-burdened mammals. Some idea of the possibilities involved can be gathered by inspection of Figures 1 and 2, which show some preliminary results obtained under conditions described in the legends.

APPARATUS

Either NaI(Tl) or CsI(Tl) cylindrical crystals, 1.5 inches in diameter, sealed in aluminum containers (3), were used as scintillators. They were coupled optically to a 6292 Dumont photomultiplier tube connected in turn to the inputs of two single-channel analyzers. One of these was adjusted to cover a 35-kev-wide band of the spectrum centered over the 186-kev photopeak of Ra^{226}, and the other to record pulses over a 200-kev band astride those emitted by RaB. Correct adjustment of the channels was effected by motorized scanning of the spectrum of a Ra source in air with the instruments feeding a count rate meter and strip chart recorder. The simultaneous reading of the two bands curtailed the necessary recording time and eliminated errors arising from uncontrollable motions of the animal.

Before proceeding further, it is well to recall that the interaction of monoergic photons with a scintillator leads to the production of light pulses by photoelectrons and Compton-recoil electrons released in the crystal. This phenomenon leads to characteristics in scintillation spectra that have been adequately described in the literature (4). It will suffice to state here that the pulses recorded in the Ra^{226} band are due not only to 186-kev photoelectrons but also to Compton-recoil electrons released by Ra(B + C) gamma rays. The extent to which these are present is readily seen by comparing the spectra of Ra and Rn in air in Figure 1.

[1] Work performed under the auspices of the U.S. Atomic Energy Commission. From the Division of Biological and Medical Research and the Radiological Physics Division, Argonne National Laboratory, Lemont, Ill. Also from the Department of Radiology, University of Chicago Medical School. Presented at the Fortieth Annual Meeting of the Radiological Society of North America, Los Angeles, Calif., Dec. 5–10, 1954.

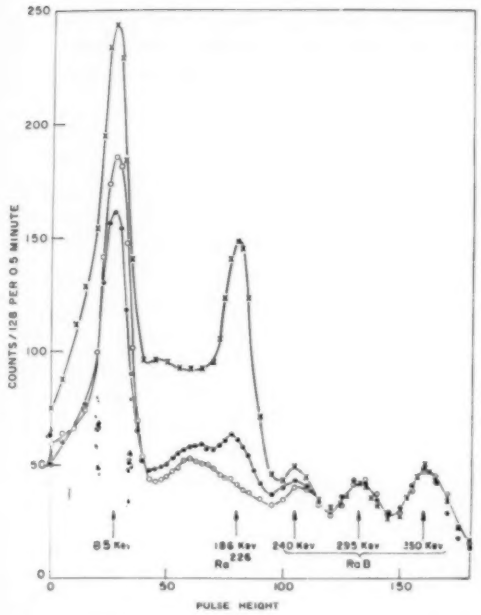

Fig. 1. Pulse height spectra from various sources. ○ Ra(B + C) in equilibrium with radon (in air). ● Ra^{226} + Ra(B + C) in equilibrium (in air). × Radium-burdened rat (No. 14–3) almost five months after injection.

Peaks at 85 kev are due to conversion x-rays arising in the chain and do not enter into this discussion. NaI crystal 1 1/2 × 1/2″.

It is obvious that, in order to extend the measurable range of the radon fraction, every effort should be made to enhance the ratio of the first to the second band. Although an irreducible limit is contributed by that part of the Ra(B + C) radiation scattered into the Ra^{226} channel by the animal (Fig. 1), definite improvements are obtained by increasing the resolution and atomic number of the crystal and by limiting its thickness to two or three half-value layers of the 186-kev radiation. It was found in practice that a 1/8-inch thick CsI crystal is preferable to the 1/2-inch thick NaI crystal, despite the higher light yield and consequent resolution of the latter.[2] In order to evaluate the radon partition in animals from readings in these bands, it was necessary to compare them to a series of similar readings

[2] More elaborate procedures (5) designed to suppress the Compton response of the crystal may prove to be a worth-while undertaking.

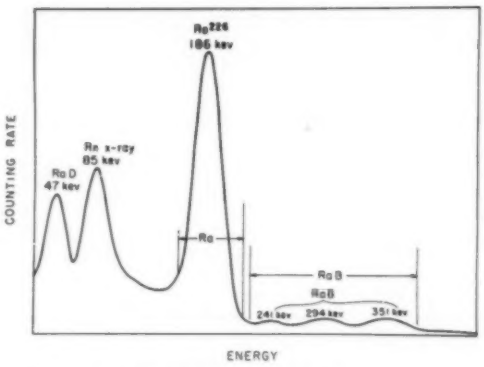

Fig. 2. Pulse height spectrum of Ra^{226} source in air with only 5 per cent of its equilibrium amount of radon. NaI crystal 1 1/2 × 1/2″.

obtained with partially de-emanated Ra sources placed at various depths in phantoms of comparable size and to assess the errors arising from the simplified procedure.

The sources consited of a few milliliters of $RaCl_2$ in acid solution, which, after being boiled in a water bath for several hours to drive off the radon and to permit decay of Ra(B + C), was sealed in soft-glass vials and placed in a plastic tube as protection against breakage. It was possible to prepare by this procedure sources with as low as 1.25 per cent radon. To simulate as close as possible absorption and scattering in live dogs and rabbits, a laminated "Presdwood" phantom, 20 × 10 × 10 cm., was used in analogous position and distance with respect to the crystals. A number of sheets were slotted to allow placing of the source at various depths, and readings with both channels were taken for each value of radon equilibrium when the source was in air and at depths of 2.8, 4.8, 7.5, and 9.6 cm. As a check on the stability of the channels, the spectrum of the source was taken in air before and after each run in the phantom; air reading in the RaB channel served implicitly as an indicator of fractional radon equilibrium when compared to that obtained with a "standard" sealed Ra source, identically placed. Both sources were then compared at full equilibrium.

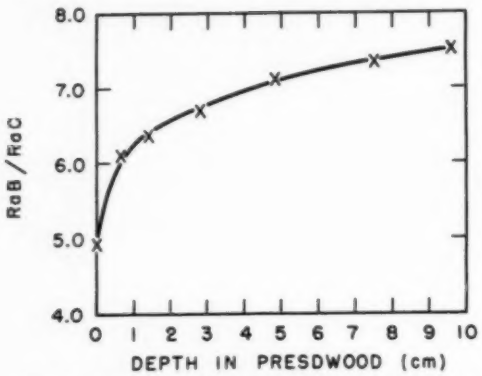

Fig. 3. The ratio of RaB to RaC counts in a 20 × 10 × 10-cm. phantom as a function of depth. NaI crystal.

Figure 3. Results on five dogs yielded an average "effective depth" of about 2.8 cm., which does not seem to be dimensionally unsound.

Although far from exhaustive, these results led to direct tests of the method in living animals, which were later sacrificed for assay. As a calibration curve in phantoms, the following expression

$$F = f_1 B / f_2 \, (Ra - k_1 B) \qquad (1)$$

was plotted as a function of radon equilibrium, where Ra and B are the counting rates in the Ra^{226} and RaB channels, and k_1 is the fraction of pulses appearing in the R^{226} channel due to Compton scatter-

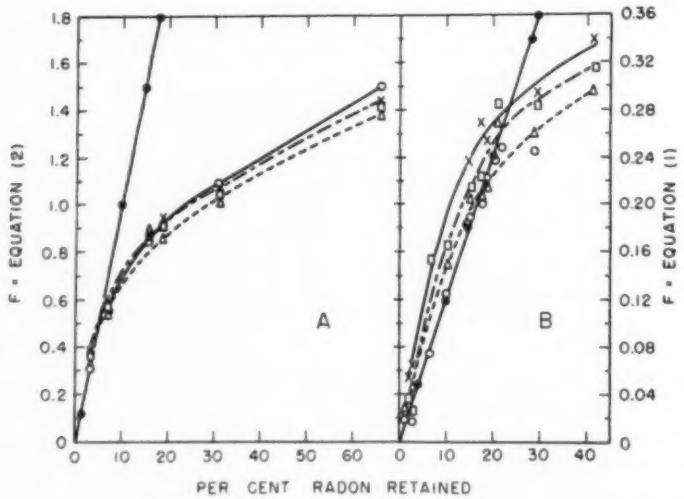

Fig. 4. Variation of F (see text) as a function of radon equilibrium in reference source placed at various depths in the phantom.
A. CsI crystal. B. NaI crystal. ● in air. □ 7.5 cm. depth. ○ 2.8 cm. depth. × 9.6 cm. depth. Δ 4.8 cm. depth.

In order to make a valid comparison between the results in animals and those obtained with the phantom, some assurance was needed that the distributed source in the former could be described in terms of a single source at a single "effective depth" in the phantom. In order to obtain the latter, counts were taken, under the RaC 607-kev line, and the RaB/RaC ratio *in vivo* was compared to ratios obtained with a source at various depths in the phantom, which are shown in

ing *within* the crystal. k_1 can be evaluated with either a radon source or by successive readings during Rn growth in the source, since the value of Ra − k_1B should be constant throughout and equal to the value in the Ra channel obtained from a completely de-emanated source. The parameters f_1 denote the mean photoelectric efficiency for the three RaB gamma rays, and f_2 refers to a similar correction for the 186-kev gamma ray, including abundance and internal conversion. The efficiencies

were taken from the work of Maeder *et al.* (6) but could also be obtained with the experimental crystal with the use of known monochromatic sources and suitable interpolation.

With the source in air, a plot of F *vs.* radon retention is linear, and the value at 100 per cent retention should be unity. The experimental value is somewhat higher, which is not surprising in view of the approximations involved in the computation of f_1 and f_2. In routine work, these factors are redundant; they were used in the present analysis to demonstrate the self-consistency of the approach. Linearity of F is essential, however, since it denotes the instrumental stability of the channels.

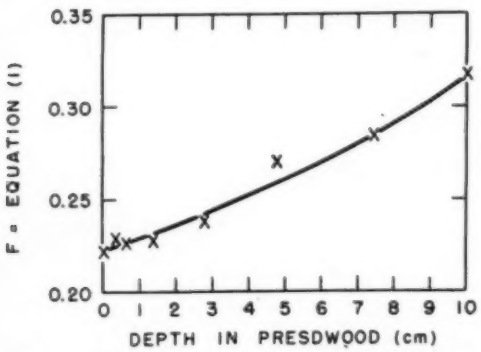

Fig. 5. Variation of F with depth in phantom—NaI crystal. Ra source with 20 per cent radon equilibrium.

The NaI crystal data, plotted as a function of Rn equilibrium in Figure 4B for different thicknesses of Presdwood between source and crystal, may be used as calibration curves for determining the radon partition *in vivo* once F is determined on the animal. Figure 5 shows the depth dependence of Equation 1 in more detail in the range of Presdwood thicknesses from 0.35 to 13.0 cm. The value in air is included for comparison.

The use of NaI crystals leads to greatest accuracy in the region from 2 or 3 per cent up to 35 to 40 per cent of equilibrium. When equilibrium is greater than 40 per cent, the uncertainty of the retention value becomes quite large.

TABLE I: COMPARISON OF RESULTS OBTAINED BY CARCASS ASSAY AND BY GAMMA-RAY SPECTROMETRY

Subject	Ra burden (μg*)	Radon retention at time of sacrifice: Radon growth	Gamma-ray method†	
Dog 219	11	29.2	31%	
Dog 67C	8	17.1	17.5	
Dog 67F	196	19.0	20.0	
Dog IIIa	9	13.7	15.0	NaI‡
Rabbit 2	78	21.1	22.0	
Rabbit 5	155	13.6	12.5	
Dog 68F	215	20.2	21.0	
Dog 75	2	18.6	22.0	CsI§

* Ra burden determined by gamma-ray technics described in Reference 1.

† Gamma-ray method using individual "effective depth," as determined by RaC/RaB ratio. See text.

‡ Experimental data obtained with NaI($1^1/_2 \times {}^1/_2$") crystal.

§ Data taken using CsI($1^1/_2 \times {}^1/_8$") crystal.

The procedure described above was repeated with the CsI crystal to investigate possible extension of the useful range. These data were plotted, using a function similar to that in Equation 1, but without correction for efficiency. Namely:

$$F = \frac{\mathrm{B}}{\mathrm{Ra} - k_1\mathrm{B}} \qquad (2)$$

where Ra, B and k_1 have the same meaning as in Equation 1. They are shown in Figures 4A and 6, Figure 4A being the plot of F versus per cent radon equilibrium and Figure 6 showing the variation with Presdwood thickness at one value of radon retention. From Figure 4 it will be seen that the retention values have a narrower spread than in the case of NaI.

The correctness of the method has been tested with laboratory animals, with both NaI and CsI crystals. Results are shown in Table I. The agreement between radon retention as obtained by this method and the values calculated by radioactive growth of the carcass after sacrifice is satisfactory for most purposes.

Slight experimental variations of this method can be readily applied to scanning of bone or other parts of the living body to observe radon partition *in situ*, and hence its dependence on various factors of anatomical or physiological interest.

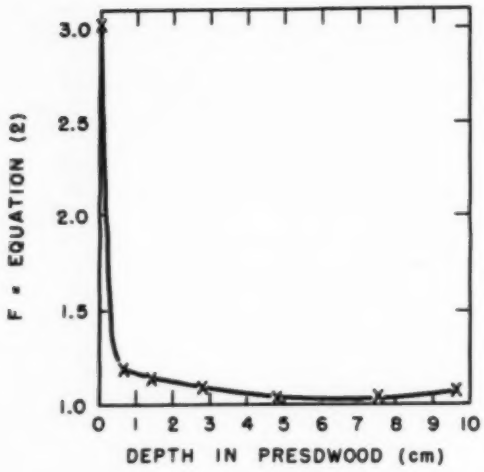

Fig. 6. Variation of F with depth in phantom—CsI crystal. Ra source with 32 per cent radon equilibrium.

The curves shown in Figure 7, which were obtained by scanning a tibia of a dog two hours after sacrifice, indicate the variations in RaB retention and the dimensional resolution attainable.

It is believed that this method, by circumventing the limitations inherent in breath sampling, can be applied to special problems concerning radium toxicity, such as the retention of Ra(B + C) through dusts deposited in the respiratory tract (7) and the mechanism of transport of insoluble radium dust in the lung (8). Although the opportunity of extending this technic to the study of human beings has not as yet presented itself, results thus far obtained suggest no contraindication to this possibility; moreover, use can be made of this method to study *in vivo* the metabolic equilibrium of other radioactive series, where the relative abundance of gamma radiation in parent-daughter elements is more favorable than in the present case.

SUMMARY

The fraction of radon retained in a radium-burdened animal can be determined experimentally *in vivo* by measuring with scintillation spectrometers the relative intensities of the Ra^{226} and RaB gamma rays emitted by the animal and by comparing them to those obtained with properly de-emanated Ra sources placed in suitable phantoms. The soundness of the technic has been proved by experiment on rabbits and dogs. The possibility of its use in other fields of investigation has been briefly discussed.

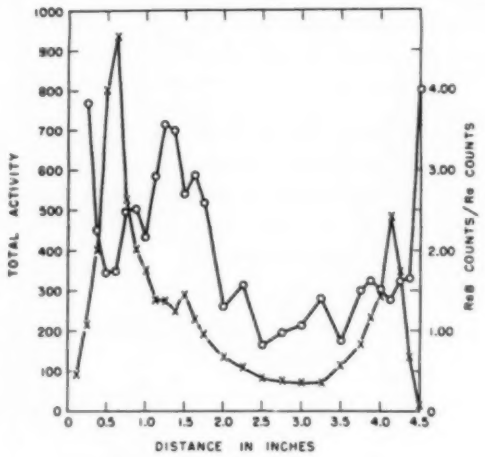

Fig. 7. Illustration of simultaneous measurements of total activity (Ra^{226} + RaB) and of RaB counts/Ra^{226} counts obtained by scanning a dog tibia with a narrow slit. The ratio, a function of RaB retention, is seen to vary with location. Abscissa indicates the distance in inches from the proximal end of the bone. ○ Total (Ra + RaB) counts per minute. × RaB/Ra counts.

ACKNOWLEDGMENT: The authors take great pleasure in acknowledging the cooperation of Dr. W. P. Norris and Mr. T. W. Speckman in making available the animals used in this investigation.

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SUMARIO

Método Espectrométrico para el Estudio del Reparto del Radón en los Animales Cargados de Radio

Cabe determinar experimentalmente *in vivo* la fracción de radón retenida en un animal cargado de radio midiendo con escintilo-espectrómetros las relativas intensidades de los rayos gamma Ra^{226} y RaB emitidos por el animal y comparándolas con las obtenidas con focos de radio debidamente des-emanados y colocados en fantasmas adecuados. La validez de esta técnica quedó demostrada por experimentos en conejos y perros, resultando satisfactorio para la mayor parte de los fines el acuerdo observado entre los resultados así obtenidos y los valores calculados a base del desarrollo radioactivo del cadáver después de sacrificar el animal.

Parece que, por evadir las limitaciones impuestas por el estudio de muestras del aliento, cabe aplicar este método a ciertos problemas especiales relacionados con la toxicidad del radio, tales como la retención de Ra (B + C) en polvos depositados en el aparato respiratorio y el transporte de polvo insoluble de radio en el pulmón.

Studies with Radioiodine

IV. Collimating Cones for Crystal Counters[1]

EARL R. MILLER, M.D., and NORMAN E. SCOFIELD, A.B.[2]

IN A CLINICAL radioiodine laboratory it is important frequently to determine the frontal area of a thyroid gland as a guide to its size, and to find out whether or not an area of the body or abnormal mass such as a metastatic thyroid tumor or a brain tumor contains I^{131} in excess of that in the surrounding tissue. If such a mass does exist, it is then important to record the fact of its existence and to establish its size, shape, position, and radioiodine content.

Unshielded and partially shielded collimated Geiger and scintillation counters, either held by hand or by some kind of scanning rack, have been used for these purposes by most workers in the field of radioactivity. Uncollimated scintillation counters have a high sensitivity to gamma rays but have poor "localizing ability" at any appreciable distance. It is possible, by limiting the acceptance angle of the crystal for radiation through the use of a collimating cone, to gain a higher order of "localizing ability," at the expense of sensitivity.

Fig. 1. Counter assembly, scanner, recorder, scalers, counting rate meter, switch box.

Single-channel collimators with small apertures have the disadvantage of using only a small portion of the crystal and therefore are of low sensitivity. In addition, the sensitivity of the counter falls off as the distance between the radioactive source and crystal is increased. Better "localizing ability," greater sensitivity of the counter with distance, and the use of as much as one-half of the crystal can all be

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achieved by the use of multichannel collimators.

The theoretical background for the design of multichannel collimators was presented by Newell, Saunders, and Miller. Consideration of the problems involved led to the fabrication and study of various types of collimators.

The effective use of collimating devices demands that there be a satisfactory apparatus for moving the counter and collimator over the area in which the radioactivity is to be measured and that there be apparatus to record properly the position of the counter and the radiation which falls on it. This paper presents a description of such an apparatus and the results of studies with different collimators.

APPARATUS

Figure 1, a photograph of the apparatus, shows a counter assembly mounted on a scanning rack, which in turn is mounted on an x-ray tube stand. The counter is connected to two scalers arranged in series. The lower scaler contains a counting rate meter; its responses are measured and recorded on the Speedomax recorder. The switch box on the top of the upper scaler permits the simultaneous starting of the recorder chart and the moving of the counter.

The counter assembly (Fig. 2) comprises a crystal scintillation counter, lead shield, collimator, and lead filter (0.5 gm./cm.^{2}). The thallium-activated sodium iodide crystal, 20 mm. thick by 40 mm. diameter, is held against the photocathode by a plastic cup filled with dehydrated mineral oil and is sealed to the photomultiplier tube with tape. The lead shield has a vertical cylindrical hole through its upper portion for the counter, and a larger, vertical, slightly tapered hole through its lower portion for the collimator.

The scanning rack, or scanner (Fig. 1), consists of a frame with sides made of two horizontal, parallel U-shaped tracks. The counter assembly is mounted on a metal plate on wheels which run in these tracks. On the surface of the plate a "nut" is fastened, through which passes a motor-driven lead screw which propels the counter assembly. It is possible to reverse the motor by switching, and its speed can be varied by means of a variac. The counter is able to "scan" in either direction from 0 to 12 inches per minute. A variac setting of "60" moves the counter at the fixed recorder chart speed of 8 inches per minute. The thread of the lead screw is short enough so that the movement of the counter assembly is arrested before it reaches the ends of the scanning rack. A knife edge on the scanner trips a microswitch on the counter when the counter passes it. This knife edge can be set to trip the switch at any predetermined point, as, for example, the mid-line of the patient. This switch is connected to the pen on the recorder and marks the position of the knife edge and the direction of scan by means of a pip on the chart.

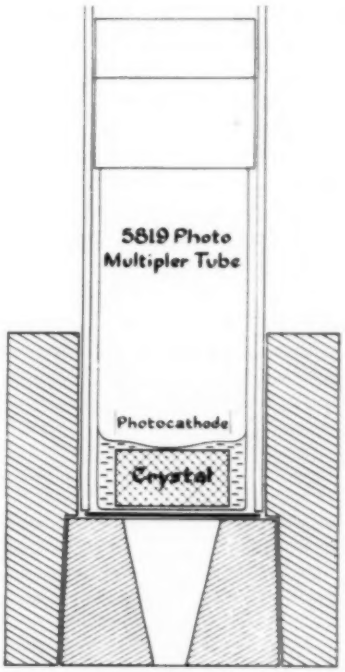


Fig. 2. Diagram of counter assembly, showing crystal scintillation counter, crystal, photomultiplier tube, lead shield, lead filter, collimator.

In scanning a patient, the position of the counter relative to his long axis and the

couch upon which he lies can be determined by recording the position of the x-ray tube stand as shown by a scale on the rail on which it is mounted behind the patient's couch (not shown in Fig. 1). The scanner can be fixed in a position at right angles to the patient's long axis by a pin through its mounting. The mid-line and long axis of the patient and the lines perpendicular to it at the level of the suprasternal notch set the coordinates of the scanning plane. The position of the counter can be changed to any point along the axis by moving the x-ray tube stand manually. The counter is motor-propelled to any position at right angles to this axis.

When this unit is used with the scanner and recorder in operation, the counter is placed so that the crystal is 17 cm. and the face of the collimator 12 cm. above the patient's skin, over the suprasternal notch. The position of the counter is determined (*a*) by recording on the chart its longitudinal position, with respect to the suprasternal notch, and (*b*) by direct measurement on the chart relative to the center mark of the recorder pen. This is possible because the counter and chart always move at the same rate of speed. Thus the amount of radiation that is emitted at any given time from any part of the patient can be recorded.

The counting rate meter was developed with the help of Mr. Hugh D. Farnsworth and Mr. William Goldsworthy (Electrical Engineering and Electronics Department, University of California Radiation Laboratory, Berkeley), who built a single counting rate meter into the scaler chassis. By the use of only one counting rate meter and the scaling circuits, it was possible to have six ranges for full-scale deflection of the meter, ranging from 3,150 to 100,000 counts per minute. The time constants are 5, 2, and 0.5 seconds. If the counting rate exceeds 100,000 counts per minute, a lead filter of known absorption is used to reduce it. The use of the scaling circuits and a single counting rate meter circuit assure the user that, if one scale is linear and properly calibrated, all scales are equally well calibrated. This unit has worked well for over three years.

This apparatus has an advantage over the Scintograph in that it actually records counts over the area scanned and thus gives quantification to a study. The Scintograph has the advantage of giving a picture of the distribution of the radiation.

STUDIES WITH COLLIMATORS

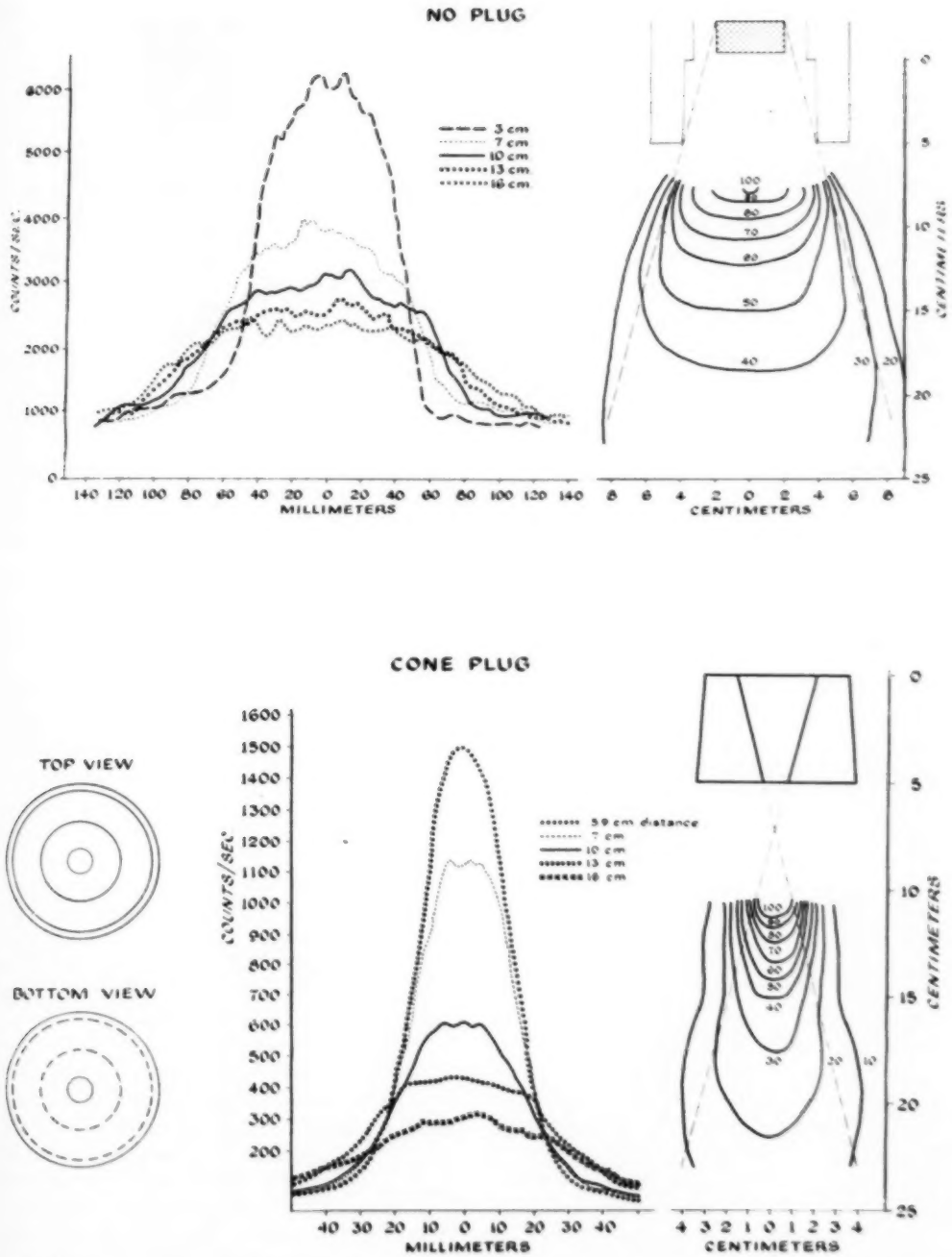
Four multichannel and two single-channel lead collimators were fabricated and were tested by studying the response of the counter to a point source of radiation. The multichannel collimators were referred to as *spiral*, *slit*, *Scott*,[3] and *honey cone*.[4] The single-channel collimators were referred to as *cone plug* and *no plug*. Figures 3 to 8 show top, bottom, and cross-sectional side views of these collimators.

The two point sources of radiation used were contained in hollow glass spheres, or "bubbles," 5 mm. in diameter. One sphere contained 44 μc I^{131}, and the other 1 μc I^{131}. These point sources were mounted in corks, which were then placed on a large, level drawing board, and the counter was adjusted for distance above the sources. Distances were measured from the center of the source to the face of the crystal and to the face of the collimator.

When a determination was to be made with a collimator over a point source, the counter first was displaced laterally with reference to the source in order that the counter might be shielded from the radiation and the background might remain constant over a distance of several centimeters of a "scan" (the chart record of a scanning run). The counter was then permitted to scan directly over the source while the response was recorded graphically on the chart. The speeds of scanning and of the paper in the recorder were the same. The data were always plotted so that the results of scanning were shown in milli-

[3] The *Scott* collimator was designed and fabricated by Dr. Kenneth Scott, Associate Professor of Experimental Radiology and Director of the Radioactivity Center, University of California School of Medicine, San Francisco.

[4] The *honey cone* collimator was fabricated from the ideal design developed by Newell *et al.*



Figs. 3 and 4. Single-channel collimators. In these and the succeeding figures, showing muliple-channel collimators (Figs. 5–8), the top and bottom views of the collimator are shown on the left, the response of the counter-collimator combination as it passes at various distances over a point source of radiation is shown in the center, a vertical cross section of the collimator is shown at the upper right, and below that are shown the isometric lines of response of the counter to the point source of the radiation (*i.e.*, at each point on an isometric line the response of the counter to a source of radiation will be the same as it is at any other point on that line).

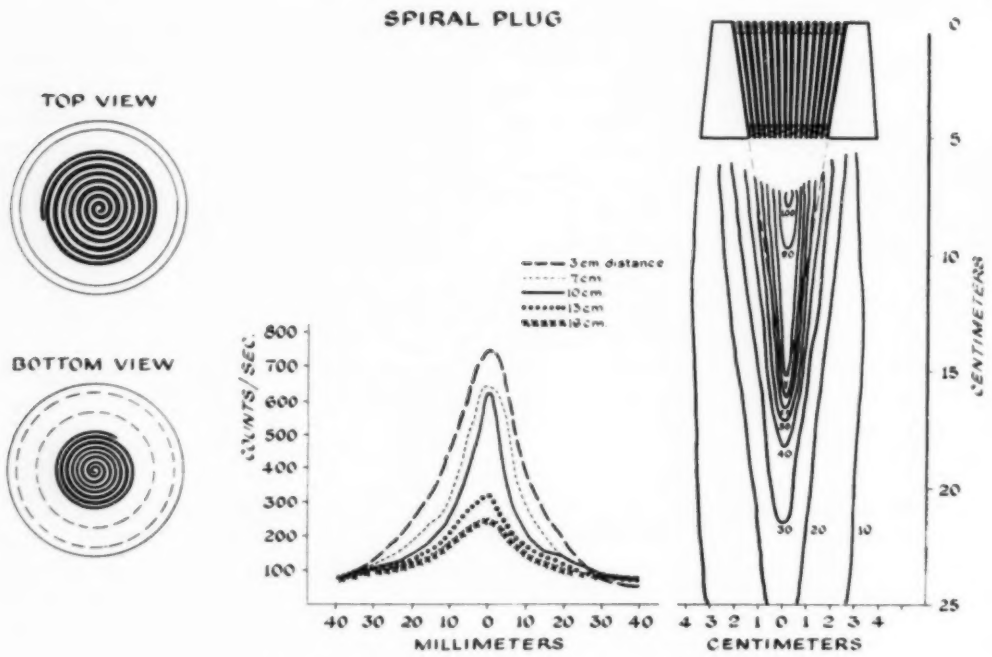


Fig. 5. For explanation see legend for Figs. 3 and 4.

meters of counter movement on the abscissa and counts per second per 44 μc I^{131} on the ordinate (Figs. 3–8). The recorded "scan" obtained with each collimator at the various distances above the source is given in the center of the figure showing the collimator. These scan curves, in addition to giving the actual number of counts per unit of time, furnish a visual impression of the sensitivity and degree of collimation for each of the counter-collimator combinations at the various distances between the source and collimator face.

In the right lower portion of each of the six figures (Figs. 3–8), directly below the vertical cross section of the collimator, are the isometric curves for that collimator. The counter's response is constant when a point source of I^{131} remains on one of the isometric curves. These isometric curves show graphically the degree of collimation and other characteristics for the counter and collimator in much the same way that isodose curves give information about the distribution of radiation in the vicinity of a source of radiation and its collimator.

The isometric curves were derived by taking the number of counts per second when the point source of I^{131} was on the collimator's central axis, at the closest distance between the face of the collimator and the source (usually 3 cm.), as 100 per cent. The positions of the points for 90, 80, 70 per cent, etc., relative to the face of the collimator were found on the scan curves. Points of equal response were joined, forming isometric curves.

The isometric curves are cross sections of isometric surfaces. With the exception of the *slit* collimator, the isometric surfaces for the various collimators have cylindrical symmetry and can be generated by rotating the isometric curves about a vertical axis through the center of the collimator. The *slit* collimator does not have such cylindrical symmetry. Its isometric surfaces are shaped like a hand, narrow in one dimension and broad in another.

Three factors were observed to be of prime importance and were the criteria

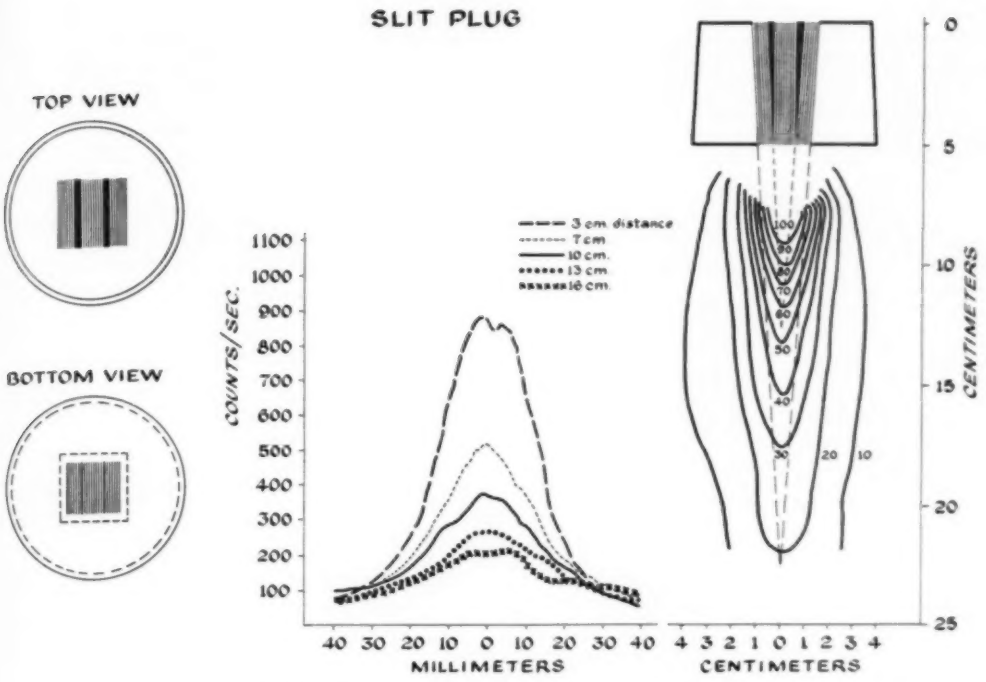


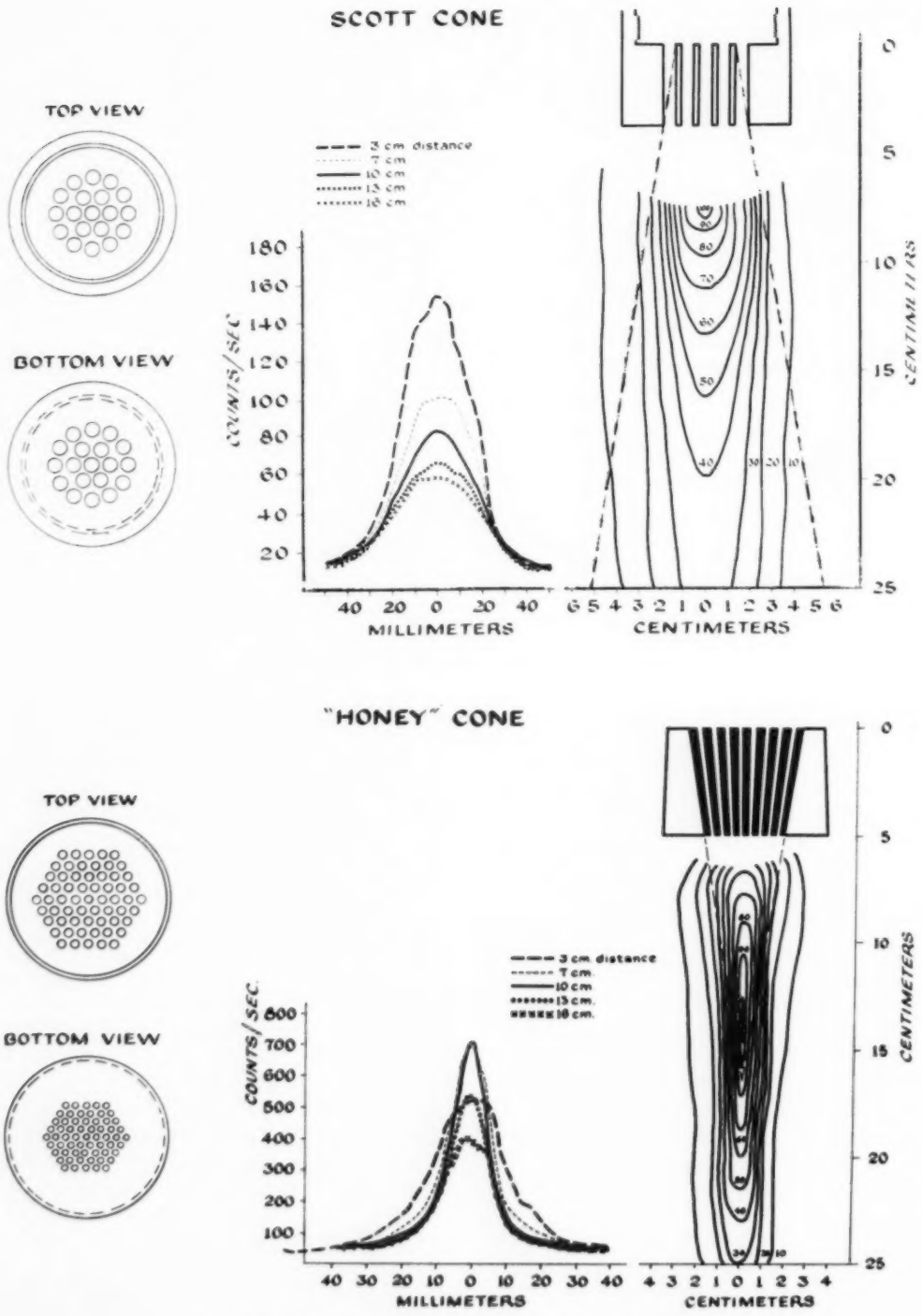
Fig. 6. For explanation see legend of Figs. 3 and 4.

employed in the evaluation of these collimators: first, sensitivity, or number of counts per second per microcurie in the source at various distances along a line perpendicular to the center of the crystal face, (*a*) above background and (*b*) when the counter's response above background is divided by background (signal-to-noise ratio); second, the position of maximum sensitivity with reference to the face of the crystal; third, degree of collimation (the relative width of the isometric plot).

The sensitivity of the counter at any distance from the point source of radiation was determined by the height (*H*) of the scan curve in counts per second (Fig. 11).

The sensitivity of a counter is dependent upon the distance between the source of radiation and crystal and upon the area of the crystal that the source "sees" through the collimator. Using the single-channel collimator, *no plug*, the source "sees" the entire crystal without obstruction as long as the source remains within the geometric extension of the sides of this cylindrical collimator. Under this condition, the counting rate is affected only by distance and size of source. Beyond the extensions of the geometric sides of the collimator, the counting rate falls because of occultation of the crystal by the lead shield.

With the other single-channel collimator, *cone plug*, the source can see the crystal as long as it remains within the focus of the collimator, when its sensitivity is equal to that of *no plug*. However, as the source is moved farther away from the face of the collimator, beyond its focus (2 cm.), its sensitivity is reduced, not only by the effect of distance but also by the effect of occultation of the crystal by the lead of which it is fabricated. It can be observed, for example, that if the source is at a distance of 15 cm. from the face of the collimator, it sees only one-tenth as much of the crystal as it did at 2 cm. from its face. With *spiral*, *slit*, and *honey cone*, multichannel collimators, approximately 50 per cent of the crystal is covered by lead for a point



Figs. 7 and 8. For explanation see legend of Figs. 3 and 4.

source at the focus of the collimator. When the point source is moved any distance from the focus, in either direction, the amount of lead between source and crystal is greatly increased and the sensitivity is thereby decreased.

The sensitivity of the counter with each of the collimators at various distances between source and collimator face is shown in Figure 9. The single-channel collimator *no plug* has the highest sensitivity. The

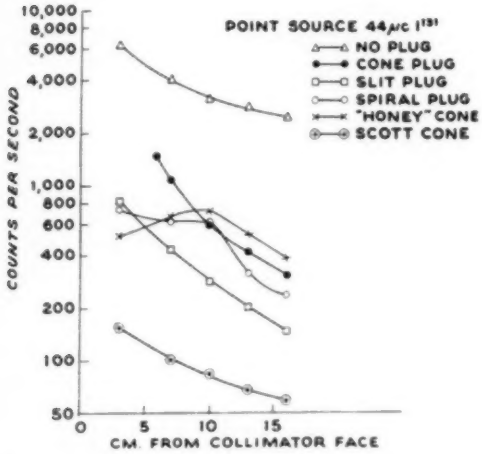


Fig. 9. Sensitivity of counter with each of the collimators, measured by number of counts/sec./microcurie of I^{131} in the point source at various distances along a line perpendicular to the center of the face of the crystal.

Scott collimator has lowest sensitivity at all distances, but its sensitivity varies least with distance between source and crystal. The others lie between. The *cone plug* has its highest sensitivity at short distances (5.9 to 7.0 cm.). The *spiral* and *slit* collimators have maximum sensitivity at the shortest distance between crystal and source (3 cm.). The *honey cone* collimator, on the other hand, is most sensitive at its point of focus, approximately 10 cm. from the face of the collimator, and at this distance its sensitivity is exceeded only by that of *no plug*. If the *spiral* and *slit* collimators had been fabricated with solid lead centers, their maximum sensitivity probably would also have been at some distance from their faces.

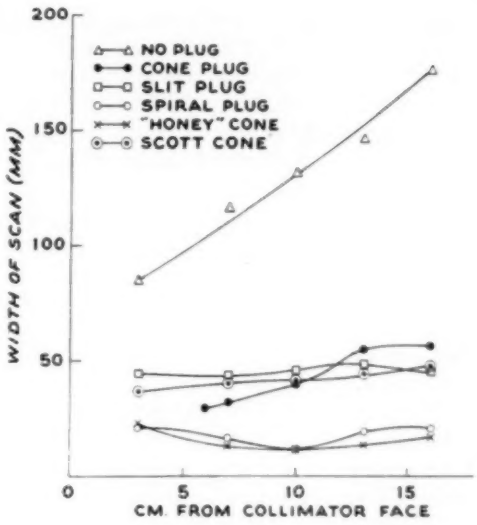


Fig. 10. Comparison of width of scan (degree of collimation) for each of the collimators.

The degree of collimation is shown by the relative widths of the recorded scans and by the relative widths of the isometric plots in Figures 3 to 8. Collimation as used in this paper is given by the reciprocal of the width of the scan curve at half height (1/W). See Figure 11.

It may be seen from Figure 10 that the highest degree of collimation (least width of isometric plot, or narrowest scan) was achieved by the *spiral* and the *honey cone* multichannel collimators, and the lowest by *no plug*. The *honey cone* collimator represents the maximum degree of collimation achieved thus far in these studies. The *slit collimator* has a fairly high degree of colli-

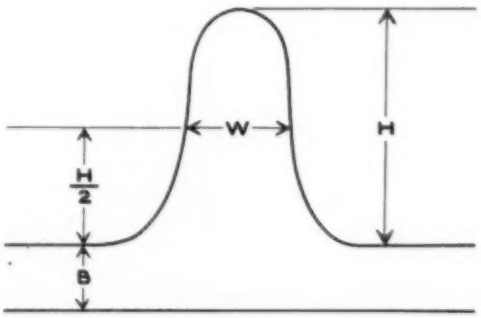


Fig. 11. Diagram showing measurements used in calculating the figure of merit.

mation in the plane perpendicular to the lead laminae of which it is constructed, but a relatively low degree in the plane parallel to the laminae. This collimator was designed to permit scanning in an isometric plane through the body of the patient.

In order to evaluate both the sensitivity and the degree of collimation in a single expression, a figure of merit was derived for the various collimators. The ratio of the counting rate from the source to that from the background (signal-to-noise ratio) is an expression of sensitivity of the counter. The reciprocal of the width of the curve for the scan at half maximum height is a measure of collimation (Fig. 11).

The figure of merit is $(H/B) \times (1/W)$, where B = background in counts/sec., H = height of scan curve above background in counts/sec., and W = width of scan curve at half maximum height (mm.).

Table I lists the figure of merit for each of the collimators at the various distances between the point source of radiation and the face of the collimator. Figure 12 presents the same material in graphic form. From these data it can be seen that, when the face of the collimator is less than 7 cm.

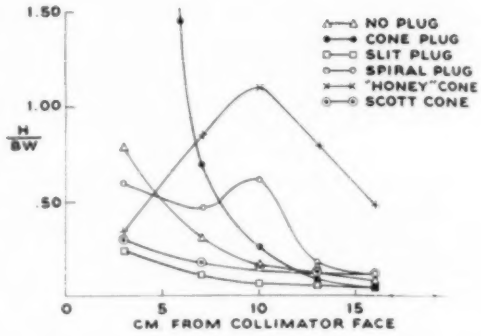
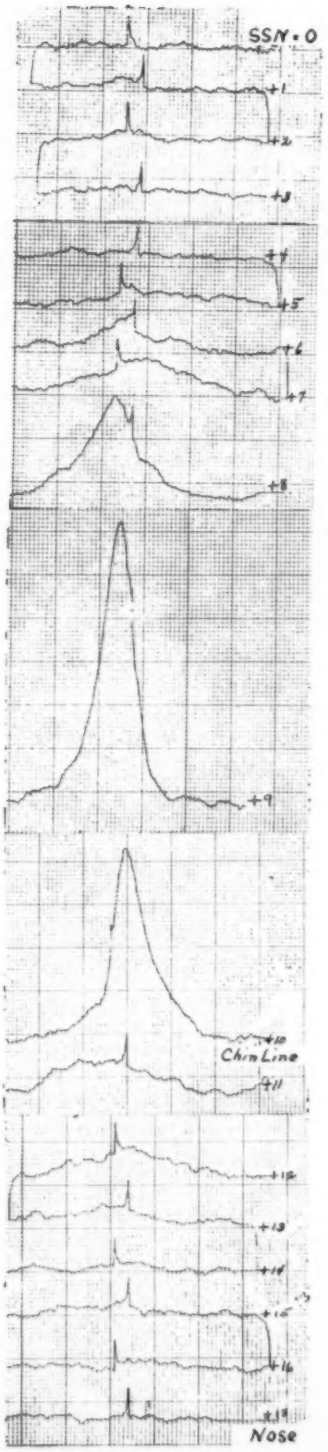


Fig. 12. Comparison of figures of merit for collimators at various distances between the point source of I^{131} and face of the collimator.

TABLE I: FIGURES OF MERIT FOR COLLIMATORS

Collimator	Distance between Source and Collimator Face (cm.)	Height, H (counts/sec)	Background, B (counts/sec)	Width, W (mm.)	Figure of Merit, H/BW
No plug	3	5,400	860	85	0.738
	7	3,120	880	116	0.305
	10	2,240	990	132	0.171
	13	1,930	880	146	0.150
	16	1,440	990	176	0.083
Cone plug	5.9	1,420	33	29.5	1.45
	7	1,050	47	32.5	0.69
	10	540	53	40	0.255
	13	346	73	55	0.086
	16	220	87	56	0.045
Slit plug	3	810	80	44	0.229
	7	435	90	43	0.112
	10	280	100	46	0.061
	13	200	70	48	0.060
	16	147	60	45	0.045
Spiral plug	3	670	53	21	0.6
	7	550	73	16.2	0.465
	10	532	73	11.8	0.616
	13	240	73	19.4	0.169
	16	166	73	20.5	0.115
Honey cone	3	459	60	22.5	0.340
	7	617	53	13.7	0.85
	10	655	53	11.2	1.10
	13	474	46	13.0	0.79
	16	343	43	16.8	0.475
Scott cone	3	142	12.5	37.5	0.304
	7	87.5	12.5	40	0.175
	10	73	11.2	41	0.159
	13	57	10.2	44	0.128
	16	49	10.2	47	0.102



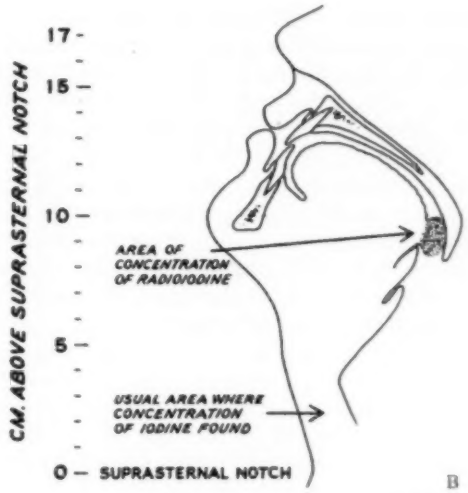


Fig. 13A. The recorded scan for the area of the face and neck of a six-year old patient with a lingual thyroid, obtained with the use of the *honey cone* collimator. The scan was made at 1-cm. intervals, in a frontal plane 12 cm. anterior to the suprasternal notch, between the suprasternal notch (SSN), taken as 0 cm., and the tip of the nose (+17 cm). The chart record of this scan indicated clearly that there was no concentration of radioiodine in the region normally occupied by the thyroid gland (about 1–5 cm.), and that there was definite evidence of a high amount of I^{131} uptake in only one small area between 8 and 10 cm. above the suprasternal notch, at the mid-line, in the region of the lingual thyroid. The fact that there was very little evidence of any uptake at the 7-cm. or the 11-cm. level demonstrated the sharpness with which the mass was delineated by the *honey cone* collimator. The lingual thyroid was found to contain 32.5 microcuries of radioiodine at the time this scan was made.

Fig. 13B. A sagittal, cross-sectional diagram of the patient's face and neck, showing the position of the area of radioiodine concentration in the lingual thyroid with relation to the position of the suprasternal notch, the region normally occupied by the thyroid, the tip of the chin, and the tip of the nose, as determined from the chart record of the scan (Fig. 13A) and from measurements on the patient at the time the scan was made.

from the source, the single-channel collimator, *cone plug*, has a much higher figure of merit than any of the other collimators. When the distance is greater than 7 cm., the *honey cone*, a multichannel collimator, has the highest figure of merit. The maximum figure of merit for the *honey cone* and for the *spiral* collimator is at their focus (10 cm.).

DISCUSSION

In a radioiodine laboratory, it is necessary almost daily to determine the size, shape, and position of a localized source of

radioactivity in the body of a patient. It became apparent early in these studies that no single device would be most efficient for accomplishing the desired end under all conditions of size and depth of source.

The body may be thought of as a "sea" of radioactivity in which the localized source of radiation is embedded. If the source of radiation is close to the surface and has a high content of radioactivity with respect to its background, its presence and position are determined quickly and easily by moving an uncollimated counter rapidly over the surface. The number of counts will be high directly over the source and will drop off rapidly as the distance between the source and the counter is increased.

When the source of radioactivity is small in size, lies far below the surface, and contains only slightly more radioactivity than its background, the problem of finding it becomes much more difficult. Under these conditions, it is necessary to use a highly collimated counter, responding with a high number of counts when it is directly over the source and a low number elsewhere. It is possible to achieve this by using a long, single-channel collimator of small diameter, but at the expense of a marked loss in sensitivity because so little of the crystal is used. The same achievement is possible with the multichannel collimators with less loss of sensitivity. When the distance between source and collimator is the distance of its focus, the highest sensitivity is maintained.

The *honey cone* collimator has an advantage over the other collimators described in this paper in that its sensitivity is low when a source of radiation is close to its face. This is a real advantage, since the counter responds poorly to that radiation coming from the background of the patient's body, which lies between a deeply placed source and the counter. The particular *honey cone* collimator described here was designed for highest sensitivity for a very small source at exactly 10 cm. from its face. It is possible to design similar collimators for a variety of conditions.

The particular value of the *honey cone* collimator when it is used to locate and to delineate small concentrations of radioiodine deeply embedded in the body was demonstrated in the case of a six-year-old patient who had a mass in the back of his tongue which was shown to be lingual thyroid. In the Radioiodine Laboratory, I^{131} uptake studies were made to determine whether or not there was any radioiodine in the thyroid gland in the neck and whether or not a concentration of radioiodine could be found in the lingual mass. The recorded scan of the area of the face and neck (Fig. 13A) and a cross-sectional view of the area scanned, indicating the position of the area of I^{131} concentration (Fig. 13B), illustrate the precision with which the mass was delineated. This scanning process required only about 20 minutes.

When a highly collimated counter is used, it is obvious that many counts close together must be made. This is a time-consuming procedure. For example, scanning a patient's neck with the *honey cone* collimator, or the chest with the *cone plug* collimator, requires about thirty minutes. The economics of counting will be discussed by Dr. Newell in a forthcoming paper.

SUMMARY

Four multichannel and two single-channel collimators were fabricated and tested for sensitivity and degree of collimation by studying the response of the counter to which they were attached, at various distances from a point source of I^{131}.

A scanning device is described for moving the counter and collimator over the point source at the same rate the response of the counter is recorded. The recorder plots a bell-shaped curve for each scan at each distance between the source and counter.

The sensitivity of each of the counter-collimator combinations is given by the height of the scan curve. The width of the curve at half its height gives a measure of the degree of collimation provided by the collimator.

A figure of merit, a single expression

evaluating both sensitivity and degree of collimation, was determined for each collimator at various distances between source and counter (collimator face). It was given by the product of signal-to-noise ratio (height of the scan curve divided by the background) and the measure of collimation (1 over the width of the scan curve at half maximum height).

It was found that, when the face of the collimator was less than 7 cm. from the source, one of the single-channel collimators in the form of an inverted cone with a 1-cm. aperture (called the *cone plug* collimator) had the highest figure of merit. At all greater distances, a multichannel collimator called the *honey cone* collimator had the highest figure of merit.

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REFERENCE

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SUMARIO

Estudios con Radioyodo. IV. Conos Colimadores para Contadores de Cristal

Fabricados cuatro colimadores de multivías y dos de una vía, fueron comprobados en cuanto a sensibilidad y calidad de la colimación, estudiando la respuesta del contador al que estaban unidos, a varias distancias de un foco en punto de I^{131}.

Descríbese un aparato escrutador que mueve el contador y el colimador sobre el foco en punto a la misma velocidad con que se registra la respuesta del contador. El registrador traza una curva campaniforme para cada escrutinio a cada distancia entre el foco y el contador.

Se consigna la sensibilidad de cada una de las combinaciones de contador-colimador a base de la altura de la curva escrutadora. El ancho de la curva a la mitad de su altura ofrece una medida de la calidad de la colimación facilitada por el colimador.

A varias distancias entre foco y contador (cara del colimador), se determina para cada colimador una "cifra de mérito," expresión esta que justiprecia tanto la sensibilidad como la calidad de la colimación. Se expresó por el producto de la proporción de señal-a-ruido (altura de la curva escrutadora dividida por el fondo) y la medida de la colimación (1 dividido por el ancho de la curva escrutadora a la mitad de la altura máxima).

Observóse que, cuando la cara del colimador quedaba a menos de 7 cm. del foco, uno de los colimadores de una sola vía en forma de un cono invertido con una abertura de 1 cm. (llamado colimador obturador en cono) mostraba la mayor cifra de mérito. A todas las distancias mayores, un colimador de multivías (llamado colimador en "cono de miel") mostraba la mayor cifra de mérito.

Fires and Explosions in Anesthesia[1]

JOHN B. DILLON, M.D.

WITH THE NORMAL safeguards imposed by good hospital construction and the intelligent management of anesthesia and necessary surgical and other procedures, the probability of being a victim of a fire or explosion while under an anesthetic is perhaps the least hazard a patient has to face in a modern hospital. No accurate statistics on deaths due to fires and explosions are at present available, due to lack of reporting on a national basis, but it is certain that the incidence is low in relation to the average anesthetic mortality rate from all causes, which is of the order of 1 in 1,500.

Explosions, because they are dramatic and frequently involve loss of life, receive considerable lay publicity, and one reads of several such accidents during the course of a year. Fires are probably more common but are usually less serious and, consequently, are seldom publicized.

One of the reasons for the infrequent occurrence of fires and explosions is the vigilance of fire prevention agencies recommending safety regulations (1). These agencies have developed sound building and safety codes, and have the power to enforce their recommendations either on a state or municipal level. When a fire or explosion occurs, one or more familiar factors are either knowingly or unknowingly involved. If the elements necessary to produce one of these known factors are handled with intelligence, it should be possible to reduce the probabilities of fires and explosions and even, for all practical purposes, to eliminate them.

Three basic elements are required for a fire or explosion: (1) Explosive gases or vapors must be present in sufficient concentration. (2) Oxygen (or a gas supporting combustion) must be present. (3) There must be a source of ignition.

EXPLOSIVE GASES OR VAPORS

The majority of gases used in anesthesia are explosive. The vapors of most of the volatile liquids employed for anesthetic purposes will either burn or explode. Cyclopropane, ethylene, vinyl ether, diethyl ether, and ethyl chloride are examples of explosive agents. Those that will not explode or burn are chloroform, nitrous oxide, and trichlorethylene.

Those gases or vapors that will ignite do so at all anesthetic concentrations, either in air or in oxygen, unless the concentration of oxygen in the atmosphere is too low to support human life. The difference in the explosibility of these agents, therefore, for practical purposes is academic. From a practical point of view, they must not be used in areas considered unsafe for explosive or inflammable agents.

OXYGEN

(*or a gas supporting combustion*)

All anesthetic gases are given with a 20 per cent, or greater, concentration of oxygen, and all anesthetic vapors should be so administered. Consequently, the combination of an explosive gas plus oxygen is present during anesthesia of this type. Nitrous oxide, while not explosive, supports combustion, and its presence in an anesthetic gas mixture containing some explosive agent in no way reduces explosibility. In fact, it enhances it.

SOURCE OF IGNITION

Sources of ignition are many and sometimes very difficult to pin-point in a given situation. The more common (2) are:

1. Static electricity.
2. Sparks from equipment switches, motors, short circuits in cords, signalling systems, and other sources not static in nature.

[1] From the Department of Surgery (Division of Anesthesia) of the University of California Medical Center at Los Angeles. Presented at the Fortieth Annual Meeting of the Radiological Society of North America, Los Angeles, Calif., Dec. 5–10, 1954.

3. Open flame.

Static Electricity: As is well known, static electricity is a result of a difference in potential between two bodies arising from the building up on one of a charge of electricity. Such charges may be caused by friction between suitable materials, such as wool or silk, or they may be built by the friction involved in walking across flooring constituted of non-conducting material. The rate and magnitude of the charge build-up on a body are a function of the resistance of the flow of electricity between bodies in the same general area. Hence, any situation which tends to reduce the resistance path between bodies in a room tends to reduce the possibility of accumulation of a static charge. One extremely important factor in this respect is the humidity of the environment of an anesthetic area. In damp climates, near the seashore, high static charges are rare. In high altitudes, on the other hand, with very dry climates, static charges are frequent and of considerable magnitude. Practically, a humidity of about 60 per cent is most satisfactory from the standpoint of controlling static charge, in that it is about the highest relative humidity consistent with comfort in an operating or other area.

Sparks from Equipment: The sources of sparks from equipment are many. Plugging into service outlets, or the breaking of such connections, is one source. Another is the presence in an explosive area of equipment that intrinsically produces sparking, such as cauteries, diathermy machines, and x-ray apparatus. The breaking of connections between two metal parts or between a non-conductive rubber part and a metal part may also produce sparking. From a practical point of view, all anesthetic vapors, with the exception of ethylene, are heavier than air. Consequently, with this exception, it has been determined that connections or service outlets over 5 feet from the floor are essentially safe. Therefore, in the absence of other safety devices, all outlets, telephones, and other possible sources of sparks must be over 5 feet from the floor level.

An interesting aspect of this problem is the occurrence of high concentrations of vapors in elevator shafts, where ventilation is not controlled, in the areas of the administration of anesthetic gases. To prevent such stagnation, it is essential that ventilation of areas of anesthetic administration be forced, with a complete change-over of the atmosphere approximately eight times per hour.

Open Flame: The presence of open flames in an explosive atmosphere is obviously contraindicated. It is also contraindicated in the presence of chloroform vapor or trichlorethylene vapor, since the products of combustion of these vapors, while not explosive, are noxious gases. Fires have been produced in the presence of an open flame where alcohol or ether has been used for the sterilization of a field. The flame produced in this instance is essentially colorless, and severe burns may be inflicted before the presence of the flame is detected.

SAFEGUARDS

The general safeguard, then, for the prevention of fires and explosions in anesthesia revolve about the following:

1. *Establishment of common electrical paths for static:* This involves the availability or the presence of conductive flooring in anesthetic areas, the intercoupling of personnel and equipment in so far as is practical, the presence of conductive rubber on machines and for castors to provide electrical pathways, conductive shoeing of personnel in the area, elimination of silk or wool clothing or blanketing in anesthetic areas, and control of humidity.

2. *Avoidance of sparking:* Explosion-proof outlets or high wall outlets for all service facilities and underwriter-approved equipment should be used wherever possible. All circuits should be completed before induction of anesthesia begins. The concentration of explosive vapors should be prevented by adequate circulation of air. These are all factors which must be considered under this category.

3. *Avoidance of combustible general an-*

esthetics and sterilizing vapors, whether explosive or not, in the presence of an open flame.

OTHER SOURCES OF EXPLOSIONS

Intestinal gas may contain explosive concentrations of methane, and this may produce a problem for the radiologist in the administration of barium enemas and other lower bowel radiological problems. Hydrogen may be released in explosive concentrations during certain procedures in the bladder due to the hydrolysis of water.

The specific safeguard against fires and explosions in anesthesia revolves about personnel. Not only is it essential for professional personnel to be aware of the problem and its solution, but it is equally or even more essential that technical assistants be informed as to this general problem. For in spite of all safety precautions that can be evolved by engineers or built into modern hospitals, it is the human element which is uncontrollable. It is essentially true that, except for the very exceptional case, every fire or explosion that occurs in surgery is due to some human error.

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1. National Fire Protective Association Bulletin 56, May, 1954.
2. Ibid. Sections 5 and 6, pages 9–20.

SUMARIO

Incendios y Explosiones en Anestesia

Todos los anestésicos gaseosos, aparte del óxido nitroso, el cloroformo y el tricloretileno, plantean graves problemas relacionados con los riesgos de explosiones. Los agentes comprendidos son ciclopropano, éter vinílico, éter dietílico y cloruro de etilo.

Aunque la incidencia de explosiones es baja, hay que tener siempre presente esa posibilidad y que aplicar todos los medios para impedir tal percance. Algunos de los modos físicos de reducir al mínimo el peligro de explosiones e incendios son la instalación apropiada del instrumental de rayos X y de los enchufes, la eliminación de substancias que produzcan descargas de electricidad estática, conexiones adecuadas con tierra, establecimiento de vías eléctricas en común que no ofrezcan más que resistencia moderada y regulación de la humedad. No obstante, el mayor elemento aislado es la ecuación personal. Hay que recordar constantemente el peligro a todo el personal afectado en las zonas en que haya posibilidad de explosiones e incendios causados por anestésicos.

EDITORIAL

Cancer of the Breast

The treatment of cancer of the breast has consisted for the most part in surgery, irradiation, and hormones, each method having its advocates chiefly among those working in the particular field. Usually hormone therapy and irradiation have been considered adjuvants to operation.

Radical mastectomy, as devised by Halsted, was founded on the sound principle of the widest possible excision of the tumor and the adjacent lymph drainage areas, where metastases are usually found. It is known, however, that metastasis may take place by way of the blood stream and that metastatic deposits may be found in various locations throughout the body. This may occur in cases where the axillary nodes were found not to be involved following radical mastectomy. Results from the best surgical clinics, according to Geschickter (1), show that if only operable cases are considered, the five-year survival rate for patients without axillary node involvement approximates 70 per cent, as compared to 25 per cent for those with axillary lesions. Geschickter also states that if all cases are considered, regardless of the stage of the disease, the five-year survival rate will be found to be about 65 per cent in the absence of axillary involvement and about 20 per cent for those with spread to the axilla. On this basis, there is an overall five-year survival rate of approximately 35 per cent. In patients who are considered to be in the primary operable stage, the incidence of axillary node involvement is about 50 per cent.

The value of radiotherapy in the care of patients with primary cancer of the breast has been questioned by many writers and praised by many others. Any evaluation of the results of radiotherapy is handicapped by the variety of methods employed since the turn of the century, a natural situation in view of the tremendous advances which have been made in therapeutic apparatus and the gradual evolution of radiotherapeutic technic.

A recent article by Professor McWhirter (2) of the Royal Infirmary, Edinburgh, recounts his experience with simple mastectomy and radiotherapy in the treatment of mammary cancer. His investigation was prompted by the inconsistency of those who, while declaring that irradiation cannot destroy breast cancer cells, nevertheless advocate radiotherapy after the radical operation, especially where the axilla has been found to be involved. Professor McWhirter decided on simple mastectomy for several reasons. He has observed that recurrences following radiotherapy alone are nearly always found in the breast itself, suggesting that it is difficult to produce complete destruction or permanent inhibition of the cancer cells in the breast. He agrees with other authors that enlarged nodes due to mammary carcinoma are at least as radiosensitive as the primary growth and that, when adequate radiotherapy has been applied to them, the results are much more permanent than in the primary growth. He believes, also, that since one must in general depend on radiation for treatment of nodes in the supraclavicular and internal mammary regions, it is natural to depend on radiotherapy also for the nodes in the axilla. He states that in patients with operable lesions the supraclavicular lymph nodes are involved in 33 per cent of cases with axillary involvement. Other reasons for simple mastectomy are that large skin flaps do not tolerate radiation well, and edema of the arm is increased when radiotherapy is combined with the radical operation.

McWhirter has noted clinically that, with a dose level of the order of 3,750 r, recurrence in the axilla is rare. He believes that hard-quality radiation in essential and the half-value layer of the beam in his cases was 3.7 mm. of copper. The dose was delivered over a three-week period, though it is thought that a four-week period might be even better. The radiation was administered to the chest wall and to the whole length of the axillary chain of lymph nodes (*i.e.*, the supraclavicular and axillary nodes). The internal mammary nodes were also irradiated. The maximum dose at any point was fixed at 4,250 r.

The results reported by McWhirter were obtained in a series of 1,882 patients seen between 1941 and 1947. All patients were staged, when they were first seen, according to the Manchester classification. In Stage I, the growth is confined to the breast. In Stage II, the primary lesion is as in Stage I but with palpable mobile nodes in the axilla. In Stage III, there is extension of the growth beyond the breast, as shown by skin involvement, and the tumor is fixed to underlying muscle. Nodes, if present, must be mobile. In Stage IV, extension beyond the breast area is shown by fixation of the nodes and of the primary tumor, supraclavicular node involvement, and metastases in skin wide of the tumor, in the opposite breast, and in distant sites. There were 581 cases classified as Stage I; 481 as Stage II; 250 as Stage III; and 569 as Stage IV. For purposes of analysis, it was assumed that every death in the series was due to malignant disease. Also, even the most advanced cases and those with distant metastases were included, which tends to mask the value of the treatment in Stages I and II. While the main method of treatment was simple mastectomy plus a full course of radiotherapy, radical mastectomy was done in a few cases, and in some no operation was performed.

In the entire series there were 1,063 patients classified as operable, and the survival rate in this group was 58 per cent. Five hundred and forty-six cases were classified as locally advanced, with a survival rate of 30 per cent. Those with distant metastases numbered 273, with a survival rate of 4 per cent. This gives an overall survival rate, for the entire series of cases, of 42 per cent. These figures appear to be somewhat better than the statistics for radical mastectomy and postoperative radiotherapy as noted by Geschickter above. They are, however, the figures of one worker who is an enthusiast for the method and who has employed an unusually thorough and exacting radiotherapeutic technic. The lack of operative morbidity and the absence of interference with the use of the arm make the method an attractive one for consideration. We believe that further study of the procedure and results are in order for its proper evaluation. Details of technic are promised for a future paper.

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1. GESCHICKTER, C. F.: Diseases of the Breast: Diagnosis, Pathology, Treatment. Philadelphia, J. B. Lippincott & Co., 1945.

2. MCWHIRTER, R.: Simple Mastectomy and Radiotherapy in the Treatment of Breast Cancer. Brit. J. Radiol. **28**: 128–139, March 1955.

ANNOUNCEMENTS AND BOOK REVIEWS

FIFTH INTER-AMERICAN CONGRESS OF RADIOLOGY

The Fifth Inter-American Congress of Radiology—the first of the Inter-American Congresses to be held in the United States—met at the Shoreham Hotel, Washington, D. C., April 24–30, 1955, under the auspices of the American College of Radiology, acting for the various radiologic organizations of the United States, and under the general sponsorship of the Inter-American College of Radiology, of which Dr. Pedro Maissa of Buenos Aires is President.

There were 1,696 registrations, including 252 from Latin America, a larger number of Latin American radiologists than has attended any previous international congress. Much of the success of the meeting was due to the careful planning of Dr. James T. Case, President of the Congress, and to those working with him, notably Drs. Lowell S. Goin, Eugene P. Pendergrass, Philip J. Hodes, Juan A. del Regato, and Earl E. Barth. Particular credit for entertainment and other special features of the meeting must be given to the Du Pont Company, the Eastman Kodak Company, the General Electric Company, Keleket X-ray Corporation, the Mallinckrodt Chemical Works, Mr. and Mrs. James Picker and Mr. and Mrs. Harvey Picker, the Standard X-ray Corporation, and the Westinghouse Electric Corporation. The numerous social occasions sponsored by these groups did much to bring together members and guests from the various countries of the western hemisphere in a cordial Pan-American friendship.

The Inaugural Session held on Sunday, April 24, was most impressive. A letter of welcome from President Eisenhower was read, after which Vice-President Nixon gave a hearty welcome to the members of the Congress, emphasizing the importance of Inter-American collaboration. Dr. James T. Case was then formally installed as President of the Fifth Inter-American Congress of Radiology by Dr. Manuel F. Madrazo and presented with the President's medal and chain, a gift from the American College of Radiology to the Inter-American College of Radiology at the meeting in Santiago in 1949.

Following addresses of welcome by Dr. Carlos Dávila, Secretary-General of the Organization of American States, and by Dr. Warren W. Furey, representing the American College of Radiology, Dr. Case delivered the presidential address, in which he outlined in some detail the evolution of the Inter-American College of Radiology and the Inter-American Congresses of Radiology, memorialized numerous accomplishments of Latin American radiologists, and stressed the responsibilities incident to the development of isotopes and the applications of atomic energy whether in war or peace.

The scientific program was an excellent one, consisting of 37 communications by outstanding workers from various centers in North and South America, Cuba, and Mexico. A comprehensive group of refresher courses, which had been arranged by Dr. C. Edgar Virden, was presented during the week. These courses were well attended and of the first quality. The scientific exhibits were numerous and instructive and were widely commended for their teaching value. A large commercial exhibit was also shown, including the latest developments in radiographic, radiotherapeutic, and isotope apparatus.

At the banquet on Thursday evening, April 28, Dr. James T. Case and Dr. Juan del Regato were presented with the medal of the Order of Merit of Carlos Finlay, and Dr. George Pfahler received at the hands of Mlle. Antoinette Béclère the 1952 medal voted by the Centre Antoine Béclère of Paris. Dr. Case was also the recipient of the Order of Merit of Boyacá. Other honors conferred during the course of the meeting were honorary fellowships in the American College of Radiology to Dr. Pedro A. Maissa of Buenos Aires and Dr. José Maria Cabello Campos of São Paulo, Brazil; the gold medal of the American College of Radiology to Dr. Case; the gold medal of the Inter-American College of Radiology to Dr. Case and to Dr. Maissa; a silver medal to Dr. Oscar F. Noguera of Buenos Aires for the best paper published during the last three years in the *Acta radiologica Interamericana;* and a silver medal to Dr. Luis Arrieta Sanchez of Panama for his outstanding contributions to Latin American radiology.

The Sixth Inter-American Congress of Radiology will be held in 1958, in Lima, Peru, with Dr. Oscar Soto as President.

AMERICAN RADIUM SOCIETY

At the annual meeting of the American Radium Society, in April, the following officers were chosen: President, Grant H. Beckstrand, Long Beach, Calif.; President-Elect, Norman A. McCormick, Windsor, Ontario; First Vice-President, Herbert E. Schmitz, Chicago, Ill.; Second Vice-President, Manuel Riebeling, Guadalajara, Mexico; Secretary, Robert E. Fricke, Mayo Clinic, Rochester, Minn.; Treasurer, Douglas Roberts, Hartford, Conn.; Chairman of the Executive Committee, Howard B. Hunt, Omaha, Nebr.

The 38th Annual Meeting of the Society will be held April 9–11, 1956, in Houston, Texas.

CHICAGO ROENTGEN SOCIETY

The newly elected officers of the Chicago Roentgen Society are: Erich M. Uhlmann, M.D., President; Irvin F. Hummon, Jr., M.D., Vice-President; R. Burns Lewis, M.D., 670 N. Michigan Avenue, Chicago 11, Secretary-Treasurer.

Meetings are held at the Sheraton Hotel the sec-

ond Thursday in October, November, January, February, March, and April, at 8 P.M.

CONNECTICUT VALLEY RADIOLOGIC SOCIETY

Recently elected officers of the Connecticut Valley Radiologic Society are Dr. Elmer Harrington, Holyoke, Mass., President; Dr. Edward Sennett, Hartford, Conn., Vice-President; Dr. Thomas Crowe, 53 Center St., Northampton, Mass., Secretary-Treasurer.

FLORIDA RADIOLOGICAL SOCIETY

At the Annual Meeting of the Florida Radiological Society, the following officers were elected for 1955–56: President, Dr. Hugh G. Reaves, Sarasota; Vice-President, Dr. James T. Sheldon, Lakeland; Secretary-Treasurer, Dr. Donald H. Gahagen, 320 Sweet Bldg., Fort Lauderdale.

INDIANA ROENTGEN SOCIETY

Recently elected to office in the Indiana Roentgen Society are John A. Robb, M.D., Indianapolis, President; Jack L. Loudermilk, M.D., Fort Wayne, Vice-President; Chester A. Stayton, Jr., M.D., 313 Hume Mansur Bldg., Indianapolis 4, Secretary-Treasurer.

Meetings are held twice a year, on the first Sunday in May and during the Fall meeting of the State Medical Association.

MARYLAND RADIOLOGICAL SOCIETY

At a meeting of the Maryland Radiological Society held May 14, 1955, at the Sheraton-Belvedere Hotel, Baltimore, the following officers were elected: Dr. Webster H. Brown, of Baltimore, President; Dr. William Thomas, of Annapolis, Vice-President; Dr. Paul W. Roman, 1810 Eutaw Place, Baltimore 17, Secretary-Treasurer.

RADIOLOGICAL SOCIETY OF NEW JERSEY

At the Annual Meeting of the Radiological Society of New Jersey, April 14, the following officers were elected for the year 1955–56: President, Dr. Salomon Silvera, Jersey City; Vice-President, Dr. Carye-Belle Henle, Newark; Secretary, Dr. George Green, 601 Grand Ave., Asbury Park; Treasurer, Dr. Leonard Ellenbogen, Atlantic City.

PHILADELPHIA ROENTGEN RAY SOCIETY

At the May meeting of the Philadelphia Roentgen Ray Society, the following officers were elected for the coming year: President, D. Alan Sampson, M.D.; Vice-President, Edwin L. Lame, M.D.; Secretary, Herbert M. Stauffer, M.D., Temple University Hospital; Treasurer, Randal A. Boyer, M.D.

TRI-STATE RADIOLOGICAL SOCIETY

New officers of the Tri-State Radiological Society are Dr. Keith T. Meyer, Evansville, Ind., President, and Dr. Eugene L. Hendershot, 118 S. E. First St., Evansville, Ind., Secretary-Treasurer.

MIDSUMMER CONFERENCE ROCKY MOUNTAIN RADIOLOGICAL SOCIETY

The Seventeenth Midsummer Conference of the Rocky Mountain Radiological Society will be held Aug. 18–20 in the Hotel Shirley-Savoy, Denver, Colo. The guest speakers will be Dr. Warren W. Furey, Chicago; Dr. Higdon B. Elkins, Iowa City, Iowa; Dr. George Z. Williams, Bethesda, Md.; Dr. Isadore Meschan, Little Rock, Ark.; Dr. John W. Hope, Philadelphia. Others participating in the program are E. Dale Trout, Ph.D., Milwaukee, Wisc.; Gilbert H. Fletcher, M.D., Houston, Texas; John P. McGraw, M.D., Houston, Texas; Ray W. Hammer, M.D., and Thomas J. Kennedy, M.D., Denver; Cyrus W. Partington, M.D., Denver; H. Milton Berg, M.D., Bismarck, N.D.; B. V. A. Low-Beer, M.D., San Francisco; Homer G. McClintock, M.D., Denver; Robert V. Elliott, M.D., Denver; Tom M. Fullenlove, M.D., San Francisco; Anthony F. Rossitto, M.D., Wichita, Kans.; J. E. Miller, M.D., Dallas, Texas.

Special features are the joint meeting with the Denver Medical Society, Thursday evening, Aug. 16, preceded by an informal Guest Speakers Dinner; the annual banquet, Friday evening; and a Saturday afternoon and evening trip to Central City, where, following dinner at the Teller House, there will be an opportunity to attend a presentation of Shaw's *St. Joan* at the Central City Opera House.

GRANTS-IN-AID IN CANCER RESEARCH

Acting for the American Cancer Society, the Committee on Growth of the National Academy of Sciences-Research Council is accepting applications for grants-in-aid for cancer research in the United States. Applications received before Oct. 1 will be considered during the winter and grants recommended at that time become effective on July 1, 1956. Investigators now receiving support will be notified regarding application for renewal.

The scope of the research program includes, in addition to clinical investigations on cancer, fundamental studies in the fields of cellular physiology, morphogenesis, genetics, virology, biochemistry, metabolism, nutrition, cytochemistry, physics, radiobiology, chemotherapy, endocrinology, and carcinogenesis. The Committee is particularly interested in encouraging research in the epidemiology of cancer.

Application blanks may be obtained from the Executive Secretary, Committee on Growth, National Research Council, 2101 Constitution Avenue, N. W., Washington 25, D. C.

BIOLOGICAL PHOTOGRAPHIC ASSOCIATION

The Twenty-fifth Annual Convention of the Biological Photographic Association, Inc., will be held this year at the Hotel Wisconsin, Milwaukee, Wisc., Aug. 31 to Sept. 2, inclusive. For further details address the Convention Chairman, Leo C. Massopust, Sr., Marquette University, School of Medicine, 561 North 15th Street, Milwaukee 3, Wisc.

THIRD INTERNATIONAL COURSE ON TOMOGRAPHY

Prof. Alessandro Vallebona will conduct the Third International Course on Tomography at the Institute of Radiology of the University of Genoa, Oct. 3–12, 1955. The course will include lectures on theory, geometrical studies, technic, and instrumentation, with illustrations of the practical application of tomography in diagnosis.

The registration fee is 10,000 Italian lira (6,000 lira for junior members, under thirty, and 4,000 for relatives accompanying members). The Secretary of the course is Dr. Luigi Oliva (Istituto di Radiologia, Ospedale S. Martino, Genova). Registration fees should be addressed to Dr. Oliva or to Cook-Wagon-Lits, general travel agent for the course, who will furnish any desired information concerning travel and hotel booking.

DR. ROSS GOLDEN HONORED

At the Annual General Meeting of the Indian Radiological Association, held in Lucknow in February 1955, Dr. Ross Golden, Visiting Professor of Radiology, School of Medicine, University of California Medical Center, Los Angeles, was unanimously elected the Sixth Sir Jagadish Bose Memorial Lecturer for the current year and awarded the Gold Medal for his outstanding contributions to the science of radiology.

Letter to the Editor

To the Editor of Radiology

DEAR DR. DOUB:

May I take advantage of the columns of RADIOLOGY to call attention to a matter that is of interest to both radiologists and ophthalmologists? Recently we have found ourselves in the embarrassing position of having failed to demonstrate radiologically fragments of blasting caps later proved to be present in the eye. After their removal, these metallic fragments were found to be somewhat opaque and readily demonstrable on the x-ray film, but when bony structures were superimposed, no shadow of a foreign body was identifiable.

It was suspected that the explanation lay in the material used in the manufacture of the caps—that the copper from which they had formerly been made had been replaced by aluminum or some other light metal. Accordingly an inquiry was addressed to a manufacturer, the Du Pont Company. This elicited the fact that the caps are now made of an alloy of aluminum, designated "Type 2SO" or "Type 52SO." The Du Pont Company states that there are a number of reasons for continuing the use of this metal in blasting caps. Its inertness toward the explosive ingredients renders it stable for long storage periods and it has also been found that better performance in some cases results from the use of aluminum.

I feel that radiologists should be aware of this change in the manufacture of these caps so that they may take it into consideration when called upon by the ophthalmologist for their identification.

DONNAN B. HARDING, M.D.
Lexington, Ky.

Books Received

Books received are acknowledged under this heading and such notice may be regarded as recognition of the courtesy of the sender. Reviews will be published in the interest of our readers and as space permits.

BONE AND JOINT X-RAY DIAGNOSIS. By MAX RITVO, M.D., Assistant Clinical Professor of Radiology, Harvard Medical School; Instructor in Radiology, Tufts College Medical School; Lecturer on Radiology, Boston University School of Medicine; Director, Department of Radiology and Roentgenologist-in-Chief, Boston City Hospital; Associate Radiologist, Beth Israel Hospital. A volume of 752 pages, with 398 figures. Published by Lea & Febiger, Philadelphia, 1955. Price $20.00.

ANGIOGRAPHIC LOCALIZATION OF INTRACRANIAL MASSES. By ARTHUR ECKER, M.D., Ph.D., State University of New York, Upstate Medical Center, Syracuse Memorial Hospital, Syracuse, N. Y., and PAUL A. RIEMENSCHNEIDER, M.D., State University of New York, Upstate Medical Center, Syracuse Memorial Hospital, Syracuse, N. Y. A volume of 434 pages, with 413 figures. Published by Charles C Thomas, Springfield, Ill., 1955. Price $13.50.

RADIOISOTOPES IN BIOLOGY AND AGRICULTURE. PRINCIPLES AND PRACTICE. By C. L. CONAR, Oak Ridge Institute of Nuclear Studies; Formerly Laboratory Director and Research Coordinator, University of Tennessee-Atomic Energy Commission Agricultural Research Program. A volume of 482 pages, with numerous illustrations, including tables and graphs. Published by McGraw-Hill Book Co., Inc., New York, N. Y., 1955. Price $9.00.

AUTORADIOGRAPHY IN BIOLOGY AND MEDICINE. By GEORGE A. BOYD, Director, Arizona Research Laboratories, Phoenix, Ariz.; formerly, Professor of Biophysics, University of Tennessee, and Senior Scientist, Oak Ridge Institute of Nuclear Studies. A volume of 400 pages, with 98 illustrations and 27 tables. Published by Academic Press, Inc., New York, N. Y., 1955. Price $8.80.

ELECTROCHEMISTRY IN BIOLOGY AND MEDICINE. Edited by THEODORE SHEDLOVSKY, Rockefeller Institute for Medical Research. Sponsored by The Electrochemical Society, New York, N. Y. A volume of 370 pages, with numerous illustrations and tables. Published by John Wiley & Sons, Inc., New York, N. Y., and Chapman & Hall, Limited, London, 1955. Price $10.50.

BASIC MECHANISMS IN RADIOBIOLOGY. III. BIOCHEMICAL ASPECTS. Nuclear Science Series, Report No. 17, Publication 367, HARVEY M. PATT, Editor. Proceedings of an Informal Conference Held at Highland Park, Ill., May 13–15, 1954, consisting of 158 pages with graphs and tables. Published by the National Academy of Sciences, National Research Council, Washington, D. C., 1954. Price $1.50.

1955 MEDICAL PROGRESS. A REVIEW OF MEDICAL ADVANCES DURING 1954. MORRIS FISHBEIN, M.D., Editor. A volume of 346 pages. Published by The Blakiston Division, McGraw-Hill Book Co., Inc., New York, N. Y., 1955. Price $5.00.

STUDIES ON THE DISTRIBUTION AND FATE OF S^{35}-LABELLED BENZYLPENICILLIN IN THE BODY. Acta radiol. suppl. 118. By SVEN ULLBERG. A monograph of 110 pages, with 36 figures and 7 tables. Published by Acta radiologica, Stockholm 2, Sweden, 1955. Price Sw. Kr. 25:—

A STUDY OF THE LOCAL ROENTGEN REACTION ON THE SKIN OF MICE, WITH SPECIAL REFERENCE TO THE VASCULAR EFFECTS. Acta radiol. suppl. 119. By FINN DEVIK. A monograph of 72 pages, with 25 illustrations. Published by Acta radiologica, Stockholm 2, Sweden, 1955. Price Sw. Kr. 15:—

PRACTICAL PHOTOGRAPHIC PROBLEMS IN RADIOGRAPHY, WITH SPECIAL REFERENCE TO HIGH-VOLTAGE TECHNIQUE. Acta radiol. suppl. 120. By OVE MATTSSON. A monograph of 206 pages, with 108 illustrations. Published by Acta radiologica, Stockholm 2, Sweden, 1955. Price Sw. Kr. 30:—

CANADIAN CANCER CONFERENCE. VOLUME I. Proceedings of the First Canadian Cancer Research Conference, Honey Harbour, Ontario, June 16–19, 1954. Edited by R. W. BEGG, Department of Medical Research, University of Western Ontario, London, Canada. A volume of 444 pages, with numerous illustrations and tables. Published by Academic Press, Inc., New York, N. Y., 1955. Price $8.80.

PRINCIPES DE RADIOBIOLOGIE. By Z.-M. BACQ, Professeur à l'Université de Liège; Membre correspondant de l'Académie royale de Médecine de Belgique, and PETER ALEXANDER, Chester Beatty Research Institute and Institute of Cancer Research, Royal Cancer Hospital, London. Préface by L. H. Gray. A volume of 478 pages, with numerous illustrations. Published by Masson et Cie, Editéurs, Paris, 1955. Price 4.250 fr. [Published in English as Fundamentals of Radiobiology. To be reviewed.]

LETALFAKTOREN IN IHRER BEDEUTUNG FÜR ERBPATHOLOGIE UND GENPHYSIOLOGIE DER ENTWICKLUNG. By ERNST HADORN, Professor de Zoologie und vergleichenden Anatomie an der Universität Zürich. A volume of 338 pages, with 129 illustrations. Published by George Thieme Verlag, Stuttgart. Distributors for the United States and Canada, Intercontinental Book Corporation, New York 16, N. Y. Price DM 39.— ($9.30).

Book Reviews

DIAGNOSTIK UND STRAHLENTHERAPIE DER GESCHWULSTKRANKHEITEN. By DR. MED. ALFRED VOGT, Frankfurt a. M. A volume of 382 pages, with 209 illustrations. Published by Georg Thieme, Stuttgart, 1955. Distributed in the United States and Canada by the Intercontinental Medical Book Corp., New York, N. Y. Price DM 72.—($17.15)

This text on the diagnosis and radiotherapy of tumors is intended primarily for the radiologist who must make his own x-ray diagnosis.

About one-fourth of the book is devoted to radiobiology. This section covers concisely almost every aspect of that field. The literature cited is extensive and is drawn from almost every nation of the globe, with many references to American and English workers.

The main part of the book is devoted to practical x-ray diagnosis and therapy. In the field of diagnosis the various methods of examination and the special radiological procedures for the best demonstration of various lesions are explained. The principles of x-ray therapy are presented, and again extensive references to the literature are given. Technical factors, however, are lightly dealt with and the author confines himself more or less to a technic of 180 kv and to contact therapy. The choice between surgery and radiotherapy is often critically discussed. A relatively long chapter is devoted to brain tumors.

In the closing chapter the author states his con-

clusion that the optimum of therapeutic efficiency is probably to be achieved only in the highly specialized tumor clinic. However, a gradual improvement in results over the years could be obtained by earlier recognition of cancer. This will always be the domain of the general practitioner and will often depend on the alertness of the local radiologist.

The book is a good reference work for the radiologist and will direct him to additional sources of information in the literature.

RADIO-DIAGNOSTIC DES OCCLUSIONS INTESTINALES AIGUES. By CLAUDE OLIVIER, Agrégé de la Faculté de Médecine de Paris, Chirurgien des Hôpitaux. Préface by Professeur Henri Mondor. A volume of 258 pages, with 318 figures. Published by Masson et Cie, 120 Boulevard Saint-Germain, Paris, 1955. Price 2.700 fr.

Roentgen studies may be of great help in the diagnosis and management of various forms of acute intestinal obstruction. The roentgenologist must be aware of the various pathologic states which may be involved in producing distention of the bowel, and may be of great aid by selecting the methods of examination which will yield the most information under various circumstances. The author of this monograph discusses the usefulness of fluoroscopy in evaluating the status of the heart, lungs, and diaphragm. Supine, upright, decubitus, and Trendelenburg positions may be utilized without contrast agents. In selected instances examination with the barium enema and occasionally use of the barium meal may yield valuable data.

Various conditions which cause mechanical and reflex ileus of the small and large intestine are discussed, with illustrations of the technics which may be of optimum value in demonstrating the pathologic pattern involved. The illustrations are numerous, well selected, and excellently reproduced.

This monograph is of definite value for surgeons and roentgenologists and other clinicians interested in emergency conditions affecting the abdomen.

RADIOLOGICAL SOCIETIES: SECRETARIES AND MEETING DATES

Editor's Note: Secretaries of state and local radiological societies are requested to co-operate in keeping this section up-to-date by notifying the editor promptly of changes in officers and meeting dates.

RADIOLOGICAL SOCIETY OF NORTH AMERICA. *Secretary-Treasurer*, Donald S. Childs, M.D., 713 E. Genesee St., Syracuse 2, N. Y.

AMERICAN RADIUM SOCIETY. *Secretary*, Robert E. Fricke, M.D., Mayo Clinic, Rochester, Minn.

AMERICAN ROENTGEN RAY SOCIETY. *Secretary*, Barton R. Young, M.D., Germantown Hospital, Philadelphia 44, Penna.

AMERICAN COLLEGE OF RADIOLOGY. *Exec. Secretary*, William C. Stronach, 20 N. Wacker Dr., Chicago 6.

SECTION ON RADIOLOGY, A. M. A. *Secretary*, Paul C. Hodges, M.D., 950 East 59th St., Chicago 37.

Alabama

ALABAMA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, J. A. Meadows, Jr., M.D., Medical Arts Bldg., Birmingham 5.

Arizona

ARIZONA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, James J. Riordan, M.D., 550 W. Thomas Rd., Phoenix. Annual meeting with State Medical Association; interim meeting in December.

Arkansas

ARKANSAS RADIOLOGICAL SOCIETY. *Secretary*, Joe A. Norton, M.D., 843 Donaghey Bldg., Little Rock. Meets every three months and at meeting of State Medical Society.

California

CALIFORNIA MEDICAL ASSOCIATION, SECTION ON RADIOLOGY. *Secretary*, H. R. Morris, M.D., 1027 D St., San Bernardino.

EAST BAY ROENTGEN SOCIETY. *Secretary*, Dan Tucker, M.D., 434 30th St., Oakland 9. Meets monthly, first Thursday, at Peralta Hospital.

LOS ANGELES RADIOLOGICAL SOCIETY. *Secretary*, Oscar Harvey, M.D., 3741 Stocker St., Los Angeles 8. Meets monthly, second Wednesday, Los Angeles County Medical Association Bldg.

NORTHERN CALIFORNIA RADIOLOGICAL CLUB. *Secretary*, H. B. Stewart, Jr., M.D., 2920 Capitol Ave., Sacramento. Meets last Monday of each month, September to May.

PACIFIC ROENTGEN SOCIETY. *Secretary*, L. Henry Garland, M.D., 450 Sutter St., San Francisco 8. Meets annually at time of California State Medical Association convention.

RADIOLOGICAL SOCIETY OF SOUTHERN CALIFORNIA. *Secretary-Treasurer*, James B. Irwin, M.D., 1831 Fourth Ave., San Diego.

SAN DIEGO RADIOLOGICAL SOCIETY. *Secretary*, C. W. Bruner, M.D., 2456 Fourth Ave., San Diego 1. Meets first Wednesday of each month.

SAN FRANCISCO RADIOLOGICAL SOCIETY. *Secretary*, Tom M. Fullenlove, M.D., 110 El Verano Way, San Francisco 27. Meets quarterly at Grison's Steak House.

SOUTH BAY RADIOLOGICAL SOCIETY. *Secretary*, Thomas N. Foster, M.D., 630 E. Santa Clara St., San Jose. Meets monthly, second Wednesday.

X-RAY STUDY CLUB OF SAN FRANCISCO. *Secretary*, James T. English, M.D., 2000 Van Ness Ave., San Francisco 9. Meets third Thursday at 7:45, Lane Hall, Stanford University Hospital.

Colorado

COLORADO RADIOLOGICAL SOCIETY. *Secretary*, Stuart A. Patterson M.D., Larimer County Hospital, Fort Collins. Meets monthly, third Friday, at University of Colorado Medical Center or Denver Athletic Club.

Connecticut

CONNECTICUT STATE MEDICAL SOCIETY, SECTION ON RADIOLOGY. *Secretary-Treasurer*, John Burbank, M.D., Meriden Hospital, Meriden. Meets bimonthly, second Wednesday.

District of Columbia

RADIOLOGICAL SECTION, DISTRICT OF COLUMBIA MEDICAL SOCIETY. *Secretary*, John A. Long, M.D., 1801 K St., N.W., Washington 6. Meets third Wednesday, January, March, May, and October, at 8:00 P.M., in Medical Society Library.

Florida

FLORIDA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Donald H. Gahagen, M.D , 320 Sweet Bldg., Fort Lauderdale. Meets in April and in October.

GREATER MIAMI RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, André S. Capi, M.D., 300 N. 20th Ave., Hollywood, Fla Meets monthly, third Wednesday, 8:00 P.M.

NORTH FLORIDA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Ivan Isaacs, M.D., 1645 San Marco Blvd., Jacksonville 7. Meets quarterly, March, June, September, and December.

Georgia

ATLANTA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Albert A. Rayle, Jr., M.D., 490 Peachtree St. Meets second Friday, September to May.

GEORGIA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Herbert M. Olnick, M.D., 417 Persons Bldg., Macon, Ga. Meets in November and at the annual meeting of the State Medical Association.

RICHMOND COUNTY RADIOLOGICAL SOCIETY. *Secretary*, Wm. F. Hamilton, Jr., M.D., University Hospital, Augusta. Meets first Thursday of each month.

Hawaii

RADIOLOGICAL SOCIETY OF HAWAII. *Secretary*, H. C. Chang, M.D., 1282 Emma St., Honolulu 13. Meets third Monday of each month.

Illinois

CHICAGO ROENTGEN SOCIETY. *Secretary-Treasurer*, R. Burns Lewis, M.D., 670 N. Michigan Ave., Chicago 11. Meets at the Sheraton Hotel, second Thursday of October, November, January, February, March, and April at 8:00 P.M.

ILLINOIS RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Stephen L. Casper, M.D., Physicians and Surgeons Clinic, Quincy.

ILLINOIS STATE MEDICAL SOCIETY, SECTION ON RADIOLOGY. *Secretary*, George E. Irwin, Jr., M.D., 427 N. Main St , Bloomington.

Indiana

INDIANA ROENTGEN SOCIETY. *Secretary-Treasurer*, Chester A. Stayton, Jr., M.D., 313 Hume-Mansur Bldg., Indianapolis 4. Meets twice a year, first Sunday in May and during Fall meeting of State Medical Association.

TRI-STATE RADIOLOGICAL SOCIETY (Southern Indiana, Northwestern Kentucky, Southeastern Illinois). *Secretary-Treasurer*, Eugene L. Hendershot, M.D., 118 S.E. First St., Evansville, Ind. Meets last Wednesday, October, January, March, and May, 8:00 P.M., at the Elks' Club, Evansville, Ind.

Iowa

IOWA RADIOLOGICAL SOCIETY. *Secretary*, James T. McMillan, M.D., 1104 Bankers Trust Bldg., Des Moines. Meets during annual session of State Medical Society, and in the Fall.

Kansas

KANSAS RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, G. S. Ripley, Jr., M.D., West Iron Ave., Salina. Meets in the Spring with the State Medical Society and in the Winter on call.

Kentucky

KENTUCKY RADIOLOGICAL SOCIETY. *Secretary*, David Shapiro, M.D., Jewish Hospital, 217 E. Chestnut St., Louisville 6. Meets monthly, second Friday, at Seelbach Hotel, Louisville.

Louisiana

ORLEANS PARISH RADIOLOGICAL SOCIETY. *Secretary*, Joseph V. Schlosser, M.D., Charity Hospital of Louisiana, New Orleans 13. Meets second Tuesday of each month.

RADIOLOGICAL SOCIETY OF LOUISIANA. *Secretary-Treasurer*, J. T. Brierre, M.D., 700 Audubon Bldg., New Orleans.

SHREVEPORT RADIOLOGICAL CLUB. *Secretary*, W. R. Harwell, M.D., 608 Travis St. Meets monthly September to May, third Wednesday.

Maine

MAINE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Walter A. Russell, M.D., Augusta General Hospital, Augusta. Meets in June, October, December, and April.

Maryland

BALTIMORE CITY MEDICAL SOCIETY, RADIOLOGICAL SECTION. *Secretary-Treasurer*, Nathan B. Hyman, M.D., 1805 Eutaw Place, Baltimore 17. Meets third Tuesday, September to May.

MARYLAND RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Paul W. Roman, M.D., 1810 Eutaw Place, Baltimore 17.

Michigan

DETROIT X-RAY AND RADIUM SOCIETY. *Secretary*, E. F. Lang, M.D., Harper Hospital, Detroit 1. Meets first Thursday, October to May, at Wayne County Medical Society club rooms.

Minnesota

MINNESOTA RADIOLOGICAL SOCIETY. *Secretary*, John R. Hodgson, M.D., The Mayo Clinic, Rochester. Meets in Spring and Fall and at annual meeting of State Medical Association.

Mississippi

MISSISSIPPI RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, James M. Packer, M.D., 621 High St., Jackson. Meets monthly, on third Tuesday, at 6:30 P.M., at the Hotel Edwards, Jackson.

Missouri

RADIOLOGICAL SOCIETY OF GREATER KANSAS CITY. E. H. Stratemeier, Jr., M.D., 1010 Rialto Bldg., Kansas City, Mo. Meets last Friday of each month.

ST. LOUIS SOCIETY OF RADIOLOGISTS. *Secretary*, Edwin C. Ernst, Jr., M.D., 3720 Washington Ave., St. Louis 8. Meets on fourth Wednesday, October to May.

Montana

MONTANA RADIOLOGICAL SOCIETY. *Secretary*, Grant P. Raitt, M.D., 413 Medical Arts Bldg., Billings. Meets annually.

Nebraska

NEBRASKA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, James F. Kelly, Jr., M.D., 816 Medical Arts Bldg., Omaha. Meets third Wednesday of each month at 6 P.M. in Omaha or Lincoln.

New England

CONNECTICUT VALLEY RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Thomas J. Crowe, M.D., 53 Center St., Northampton, Mass. Meets second Friday of October and April.

NEW ENGLAND ROENTGEN RAY SOCIETY. *Secretary*, Stanley M. Wyman, M.D., Massachusetts General Hospital, Boston 14. Meets monthly on third Friday, October through May, at the Hotel Commander, Cambridge, Mass.

New Hampshire

NEW HAMPSHIRE ROENTGEN SOCIETY. *Secretary*, Albert C. Johnston, M.D., 127 Washington St., Keene.

New Jersey

RADIOLOGICAL SOCIETY OF NEW JERSEY. *Secretary*, George G. Green, M.D., 601 Grand Ave. As ury Park. Meets at Atlantic City with State Medical Society and midwinter in Elizabeth.

New York

BUFFALO RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Clayton G. Weig, M.D., 135 Linwood Ave., Buffalo. Meets second Monday, October to May.

CENTRAL NEW YORK ROENTGEN SOCIETY. *Secretary*, Dwight V. Needham, M.D., 608 E. Genesee St., Syracuse 2. Meets in January, May, and October.

KINGS COUNTY RADIOLOGICAL SOCIETY. *Secretary*, Solomon Maranov, M.D., 1450 51st St., Brooklyn 19. Meets fourth Thursday, October to April (except December), at 9:00 P.M., Kings County Medical Bldg.

NASSAU RADIOLOGICAL SOCIETY. *Secretary*, Alan E. Baum, M.D., Hicksville, N. Y. Meets second Tuesday, February, April, June, October, and December.

NEW YORK ROENTGEN SOCIETY. *Secretary*, Maxwell H. Poppel, M.D., 550 First Ave., New York 16.

NORTHEASTERN NEW YORK RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Donald H. Baxter, M.D., Albany Hospital, Albany. Meets in the capital area second Wednesday, October, November, March, and April. Annual meeting in May or June.

RADIOLOGICAL SOCIETY OF NEW YORK STATE. *Secretary-Treasurer*, Mario C. Gian, M.D., 610 Niagara St., Buffalo. Meets annually with the State Medical Society.

ROCHESTER ROENTGEN-RAY SOCIETY. *Secretary-Treasurer*, Charles E. Sherwood, M.D., 260 Crittenden Blvd., Rochester. Meets at Strong Memorial Hospital, 8:15 P.M., last Monday of each month, September through May.

WESTCHESTER RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Maynard G. Priestman, M.D., New Rochelle Hospital, New Rochelle, N. Y. Meets third Tuesday of January and October and at other times as announced.

North Carolina

RADIOLOGICAL SOCIETY OF NORTH CAROLINA. *Secretary*, Waldemar C. A. Sternbergh, M.D., 1400 Scott Ave., Charlotte 2. Meets in April and October.

North Dakota

NORTH DAKOTA RADIOLOGICAL SOCIETY. *Secretary*, Marianne Wallis, M.D., Minot. Meets in the Spring with State Medical Association; in Fall or Winter on call.

Ohio

OHIO STATE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, M. M. Thompson, Jr., M.D., 316 Michigan St., Toledo

CENTRAL OHIO RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Arthur R. Cohen, M.D., 41 S. Grant Ave., Columbus. Meets second Thursday, October, November, February, April, and June, 6:30 P.M., Fort Hayes, Hotel Columbus.

CLEVELAND RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, H. F. Inderlied, M.D., 11311 Shaker Blvd., Cleveland 4. Meets at 6:45 P.M. on fourth Monday, October to April, inclusive.

GREATER CINCINNATI RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Wm. R. Dickens, M.D., Cincinnati General Hospital, Cincinnati 29. Meets first Monday of each month, September to June, at Cincinnati General Hospital.

MIAMI VALLEY RADIOLOGICAL SOCIETY. *Secretary*, W. S. Koller, M.D., 60 Wyoming St., Dayton. Meets monthly, second Friday.

Oklahoma

OKLAHOMA STATE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, John R. Danstrom, M.D., Medical Arts Bldg., Oklahoma City.

Oregon

OREGON RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Fred C. Shipps, M.D., 214 Medical-Dental Bldg., Portland 5. Meets monthly, second Wednesday, October to June, at 8:00 P.M., University Club, Portland.

Pacific Northwest

PACIFIC NORTHWEST RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, J. Richard Raines, M.D., 214 Medical-Dental Bldg., Portland 5, Ore. Meets annually in May.

Pennsylvania

PENNSYLVANIA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, James M. Converse, M.D., 416 Pine St., Williamsport 8. Meets annually.

PHILADELPHIA ROENTGEN RAY SOCIETY. *Secretary*, Herbert M. Stauffer, M.D., Temple University Hospital, Philadelphia 40. Meets first Thursday of each month at 5:00 P.M., from October to May, in Thompson Hall, College of Physicians.

PITTSBURGH ROENTGEN SOCIETY. *Secretary-Treasurer*, Norman Tannehill, M.D. Meets monthly, second Wednesday, at 6:30 P.M., October to May, at the Hotel Roosevelt.

Rocky Mountain States

ROCKY MOUNTAIN RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, John H. Freed, M.D., 4200 East Ninth Ave., Denver 7, Colo.

South Carolina

SOUTH CAROLINA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Samuel W. Lippincott, M.D., 103 Rutledge Ave., Charleston. Meets with State Medical Association in May.

South Dakota

RADIOLOGICAL SOCIETY OF SOUTH DAKOTA. *Secretary-Treasurer*, Donald J. Peik, M.D., 303 S. Minnesota Ave., Sioux Falls. Meets during annual meeting of State Medical Society.

Tennessee

MEMPHIS ROENTGEN CLUB. *Secretary*, Benjamin E. Greenberg, M.D., 294 Annella St., Memphis 11. Meets first Monday of each month at John Gaston Hospital.

TENNESSEE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, George K. Henshall, M.D., 311 Medical Arts Bldg., Chattanooga 3. Meets annually with State Medical Society in April.

Texas

DALLAS-FORT WORTH RADIOLOGICAL CLUB. *Secretary*, Albert H. Keene, M.D., 3707 Gaston Ave., Suite 116, Dallas. Meets monthly, third Monday, 6:30 P.M., at the Greater Fort Worth International Airport.

HOUSTON RADIOLOGICAL SOCIETY. *Secretary*, W. C. Owsley, M.D., 6409 Fannin, Houston 25. Meets fourth Monday at Texas Children's Hospital.

SAN ANTONIO-MILITARY RADIOLOGICAL SOCIETY. *Secretary*, Hugo F. Elmendorf, Jr., M.D., 730 Medical Arts Building, San Antonio 5, Texas. Meets at Brook Army Medical Center, the first Monday of each month.

TEXAS RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, R. P. O'Bannon, M.D., 650 Fifth Ave., Fort Worth. Next meeting Jan. 20–21, 1956, Fort Worth.

Utah

UTAH STATE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Angus K. Wilson, M.D., 343 S. Main St., Salt Lake City 1. Meets third Wednesday, January, March, May, September, November.

Virginia

VIRGINIA RADIOLOGICAL SOCIETY. *Secretary*, P. B. Parsons, M.D., 1308 Manteo St., Norfolk 7.

Washington

WASHINGTON STATE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Eva L. Gilbertson, M.D., 1317 Marion St., Seattle 4. Meets fourth Monday, September through May, at 610 Pine St., Seattle.

West Virginia

WEST VIRGINIA RADIOLOGICAL SOCIETY. *Secretary*, W. Paul Elkin, 515–519, Medical Arts Bldg., Charleston. Meets concurrently with annual meeting of State Medical Society, and at other times as arranged by Program Committee.

Wisconsin

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SECTION ON RADIOLOGY, STATE MEDICAL SOCIETY OF WISCONSIN. *Secretary*, Abraham Melamed, M.D., 425 E. Wisconsin Ave., Milwaukee 2. Meets in October with State Medical Society.

UNIVERSITY OF WISCONSIN RADIOLOGICAL CONFERENCE. Meets first and third Thursday at 4 P.M., September to May, Service Memorial Institute.

WISCONSIN RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, W. W. Moir, M.D., Sheboygan Memorial Hospital, Sheboygan.

Puerto Rico

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CANADA

CANADIAN ASSOCIATION OF RADIOLOGISTS. *Honorary Secretary-Treasurer*, D. L. McRae, M.D., *Assoc. Hon. Secretary-Treasurer*, Guillaume Gill, M.D., *Central Office*, 1555 Summerhill Ave., Montreal 25, Quebec. Meets in January and June.

LA SOCIÉTÉ CANADIENNE-FRANÇAISE D'ELECTRO-RADIOLOGIE MÉDICALES. *General Secretary*, Ls Ivan Vallée, M.D., Hôpital Saint-Luc, 1058 rue St-Denis, Montreal 18. Meets third Saturday of each month.

L'ASSOCIATION DES RADIOLOGISTS DE LA PROVINCE DE QUEBEC. ASSOCIATION OF RADIOLOGISTS OF THE PROVINCE OF QUEBEC. *Secretary*, Jean-Louis Léger, M.D., 1560 Sherbrooke St. East, Montreal, P. Q. Meets four times a year.

CUBA

SOCIEDAD DE RADIOLOGÍA Y FISIOTERAPÍA DE CUBA. *Secretary*, Dr. Rafael Gómez Zaldívar. Offices in Hospital Mercedes, Havana. Meets monthly.

MEXICO

SOCIEDAD MEXICANA DE RADIOLOGÍA, A. C. *Headquarters*, Calle del Oro, Num. 15, Mexico 7, D. F. *Secretary General*, Dr. Guillermo Santín. Meets first Monday of each month.

PANAMA

SOCIEDAD RADIOLÓGICA PANAMEÑA. *Secretary-Editor*, Luis Arrieta Sánchez, M.D. Apartado No. 86, Panama, R. de P.

ABSTRACTS OF CURRENT LITERATURE

ROENTGEN DIAGNOSIS

The Head and Neck

The Chest

The Cardiovascular System

The Digestive System

The Diaphragm; Hernia

The Bones and Joints; The Spinal Canal

Gynecology and Obstetrics

The Genitourinary System

The Adrenals

Miscellaneous

RADIOTHERAPY

RADIOISOTOPES

RADIATION EFFECTS

RADIOBIOLOGY; RADIOCHEMISTRY

ROENTGEN DIAGNOSIS

THE HEAD AND NECK

Complications of Cerebral Angiography. Alberto D. Kaplan and A. Earl Walker. Neurology **4**: 643–656, September 1954.

Five hundred consecutive cerebral angiographic examinations, performed on 484 patients at the Johns Hopkins Hospital between February 1951 and April 1953, were reviewed to determine untoward reactions from the procedure. Thirty-six patients (7.2 per cent) either died before leaving the hospital or had definite clinical reactions. While 17 patients died, it is doubted that angiography was etiologically related to death in 13 instances; accordingly the corrected morbidity would be 4.6 per cent and mortality 0.8 per cent. Hemiplegia, paresthesias, or aphasia followed or became temporarily more severe in 10 cases. Convulsions occurred in 4, visual disturbances in 2, urticaria in 2, and clinically significant neck hematoma in 2.

Cerebral angiography was carried out under local infiltration anesthesia (1 per cent procaine) except in patients under the age of twelve and in some 15 uncooperative adults; in these cases general anesthesia (ether or Pentothal) with an intratracheal tube was used. In all cases sensitivity to Diodrast was checked by a conjunctival test thirty to forty-five minutes before the injection. In no instance was the test interpreted as positive, even in patients who had had previous angiography with the same contrast medium. Direct percutaneous puncture of the carotid (491 cases) and vertebral arteries (8 cases) were made; in 1 patient, a child one year of age, the carotid artery was exposed in the neck and arteriography performed under direct visualization. Diodrast 35 per cent was used in all but 1 case, in which a retrograde injection of the carotid artery was performed with 52.5 per cent Diodrast. The total amount introduced varied from 30 to 90 c.c. in adults and from 10 to 30 c.c. in children under twelve. Lateral and anteroposterior stereoscopic views were taken in the majority of cases to show arterial, capillary, and venous phases of the cerebral circulation. Ordinarily 12 films were exposed.

Neither sex nor race seemed to play a role in the incidence of complications. In patients over fifty years of age, complications of all types appeared to be more frequent than in younger patients. Vascular disease is associated with a much higher incidence of complications than neoplastic or convulsive disorders. This is true irrespective of whether the vascular disease is the primary condition or merely a secondary complicating factor. In the present series, patients with a systolic blood pressure greater than 160 mm. Hg represented 12 per cent of the complications, whereas those with a normal blood pressure represented only 3.7 per cent. Any factors tending to decrease the rate of the vascular circulation appear to increase the incidence of complications. The authors believe that angiography within hours of a cerebral accident is attended by a greater risk than when performed after the initial shock has passed, and they favor waiting nine or ten days after rupture of a cerebral aneurysm before carrying out angiographic studies unless the presence of an intracerebral hematoma is strongly suspected.

Complications of angiography may be prevented by careful attention to the selection of cases and the technic of the procedure. The authors believe it is unwise to subject a moribund patient to angiography when there is no chance that he could survive surgery if a condition amenable to operation were demonstrated. Acute anaphylactic shock may be avoided by the routine testing of patients, but unfortunately only a small proportion of the complications may be prevented by this means. There is little good evidence that prophylactic drugs, such as the vasodilator, Papaverine, are effective. Care in the actual puncture or injection of the contrast material may prevent air and blood emboli. If the contrast medium is not seen in the intracranial vessels on the first films taken, it is wise not to make further injections, for the likelihood of complications is great. At a later time angiography may be repeated without difficulty, or some other diagnostic procedure may be employed.

The actual technic of carotid puncture may be greatly simplified if the patient is under adequate sedation and anxiety is allayed. Barbiturates such as Phenobarbital may serve two purposes, to decrease nervousness and to inhibit convulsions.

One graph; 1 table.

Percutaneous Vertebral Angiography. Pierre Namin. J. Neurosurg. **11**: 442–457, September 1954.

The author reviews the subject of vertebral angiography on the basis of an experience with 162 percutaneous injections. Two methods for puncturing the artery are used: through the anterolateral region of the neck and at the base of the cranium. The technics are described in detail.

With the aid of several examples, the characteristic pathologic patterns are described. The method finds its greatest value in the diagnosis of tumors in the region of the cerebellopontine angle and of the clivus. The pathognomonic sign of a tumor in the angle, in the anteroposterior view, is the lateral displacement of the point of division of the basilar trunk. This sign is accompanied by deformity of the peripeduncular arch. The method has not proved helpful in localizing tumors of the cerebellar hemispheres.

In this series there were only 4 serious accidents, of which 2 were fatal. The author believes the procedure to be a relatively benign one if proper precautions are observed.

Eleven roentgenograms.

THEODORE E. KEATS, M.D.
University of California, S. F.

Encephalographic Study of the Normal Morphology of the Occipital Horns. Sergio Chiappa. Radiol. med. (Milan) **40**: 856–864, September 1954. (In Italian)

In a study of 1,000 normal encephalograms, both occipital horns were found to be well demonstrated in only 39.7 per cent. A series of sketches illustrate the varieties of indentations in the superior border of the occipital horn from the forceps major, the varieties of indentations in the inferior border from the calcar avis, and the varieties of complete truncation caused by the combined effects of the forceps major and calcar avis.

Two roentgenograms; 23 drawings; 1 diagram.

CHRISTIAN V. CIMMINO, M.D.
Fredericksburg, Va.

Controlled Transorbital Leukotomy. William A. Nosik. J. Neurosurg. **11**: 458–462, September 1954.

A method of transorbital leukotomy is described, in which a specially designed leukotome with a retractable cutting loop is used to produce a selective and more restricted lesion under x-ray control. The operation is undertaken only after roentgenograms of the head have been obtained to exclude factors which might complicate the transorbital approach, namely, aberrant ethmoid cells with infection, malformations or thickening of the orbital plate, osteomas of the orbital plate, and intraorbital tumors. The placement and the manipulation of the leukotome are also followed by roentgen studies. By this means it is believed that greater accuracy and safety are assured the patient in the production of the surgical lesion and a more permanent record can be obtained to aid in future correlative studies between the size and position of the lesion produced and the result obtained.

In 32 operations of this type, there was no mortality that could in any way be attributed to the operation.

One photograph. THEODORE E. KEATS, M.D.
University of California, S. F.

Vascular Malformations in the Region of the Great Vein of Galen. Lyle A. French and William T. Peyton. J. Neurosurg. **11**: 488–497, September 1954.

A series of 5 cases of arteriovenous malformations located in the mid-line in the region of the pineal gland is presented. All were of congenital origin, being arteriovenous shunts with drainage into the great vein of Galen. In 2 of the cases the communication was between the anterior cerebral artery group and the great vein of Galen; in 2 it was between the posterior cerebral artery group of vessels and the great vein of Galen, and in 1 it was between the superior cerebellar artery and the great vein of Galen. In each the diagnosis was established by angiography, and each case is presented in detail.

Provided one can discern on angiographic studies the vessels leading to the malformation, it is possible to make a direct operative attack on the entering vessel, thereby obliterating or at least diminishing the size of the malformation.

Eight roentgenograms.

THEODORE E. KEATS, M.D.
University of California, S. F.

THE CHEST

Bronchography. A Study of Its Techniques and the Presentation of an Improved Modification. Kenneth L. Diehl. Arch. Otolaryng. **60**: 277–290, September 1954.

The author reviews the various technics employed for bronchography and presents his own, which is a combination of the nasal and transglottic methods.

Fourteen roentgenograms; 1 photograph.

An X-ray Study of Spontaneous Pneumothorax Due to Cancer Metastases to the Lungs. Robert S. Sherman and Earl E. Brant. Dis. of Chest **26**: 328–337, September 1954.

Seven case reports of pneumothorax due to metastatic tumor are presented, and 9 similar reports from the literature are summarized. Seven cases in the combined series were bilateral. In 8 of the 9 cases from the literature, the primary lesion was a sarcoma and in 1 an Ewing's tumor. The authors' series included 4 sarcomas, 2 Ewing's tumors, and 1 carcinoma.

It is postulated that pneumothorax follows the occurrence of a bronchopleural fistula due to tumor necrosis.

Twelve roentgenograms; 1 table.

RICHARD E. BUENGER, M.D.
Chicago, Ill.

Miliary Pulmonary Hemosiderosis in the Roentgenogram. R. Haubrich and E. Versen. Fortschr. a. d. Geb. d. Röntgenstrahlen **81**: 346–354, September 1954. (In German)

Pulmonary hemosiderosis occurs secondarily to mitral stenosis with or without chronic pulmonary congestion. It can be observed in 5 per cent of all cases of stenosing mitral valve lesions, with a male preponderance of 4 to 1, though ordinarily mitral valve lesions are more frequent in females. Twenty-five cases were seen by the authors. The average age of the patients was thirty-five years and the average cardiac history ten years.

Roentgenologically, interstitial reticulation interwoven with fine granular nodulation is observed. The arrangement is symmetrical, the lesions being most conspicuous in the central parts and fading toward the periphery of both pulmonary fields. The process may remain unchanged for a long period of time. Tomography is helpful for the recognition of the finer details. In the differential diagnosis, pneumoconiosis with cor pulmonale is to be excluded.

The development of hemosiderosis depends on certain hemodynamic changes of the lesser circulation. Pulmonary congestion usually develops in earlier life and later becomes fully or intermittently compensated. Such a course appears to be necessary for the development of pulmonary hemosiderosis.

Eight roentgenograms. ERNEST KRAFT, M.D.
Newington, Conn.

Roentgenologic Changes of the Lung Associated with Isoniazid Therapy in Pulmonary Tuberculosis. David Salkin and J. A. Schwartz. Dis. of Chest **26**: 255–263, September 1954.

One hundred and six patients with pulmonary tuberculosis were treated with Isoniazid for periods of three to six months, and the effects on various types of lesions were observed roentgenographically. There were 135 areas of active infiltrations, which the authors classify as exudative, exudative-productive, productive, and productive-fibroid. Roentgen improvement occurred in 65, 37, 14, and 4 per cent of these groups, respectively, the greatest improvement being observed in the more recent exudative lesions, in those of minimal or moderate extent, and in Streptomycin-sensitive cases. One hundred and seven cavities, occurring in 81 patients, were similarly classified. Twenty-three per cent of these decreased in size. Fibroid cavities were least affected (7 per cent).

Improvement manifested itself in one to three months and the greatest change occurred within the first five months, after which time tests showed that full Isoniazid resistance had developed. Infiltrations continued to improve in spite of Isoniazid resistance; continued improvement of cavities was less common.

Of the patients showing a favorable effect roentgenographically, 95 per cent were symptomatically improved; of those whose roentgenograms remained un-

changed, 60 per cent experienced some symptomatic benefit.

RICHARD E. BUENGER, M.D.
Chicago, Ill.

Meningoceles of Intrathoracic Development. Ch. Gernez-Rieux and G. Lepaul. J. franç. de méd. et chir. thorac. **8**: 633–653, 1954. (In French)

Previous reports of meningocele developing within the thorax are cited and a case is recorded. The patient, a 59-year-old male with tuberculosis of the right upper pulmonary lobe, had been afflicted with headaches and right lower thoracic neuralgia for many years. A thoracic kyphoscoliosis and pigeon-breast deformity were present. A postero-anterior roentgenogram revealed a rounded homogeneous shadow, 4 cm. in diameter, in the right cardiophrenic angle. A lateral view showed the opacity to be in the paravertebral area. Tomographic studies demonstrated an anomaly of the right costo-transverse articulation at the ninth thoracic level and indicated that the chest lesion was connected with the spinal canal. A transthoracic aspiration yielded spinal fluid. Injection of a few drops of Lipiodol confirmed the continuity of the sac with the spinal canal.

Clinical data on 23 cases collected from the literature are tabulated. Thirteen patients (58 per cent) had neurofibromatosis, and 19 (82 per cent) had associated osseous lesions. Therapy in 12 instances consisted of excision, with a good result in 8. A correct preoperative diagnosis was made in 9 cases. Other preoperative diagnoses were neurinoma in 12 patients and hydatid cyst in 1. In the remaining case no preoperative diagnosis was given. The patients exhibited an age range of seven weeks to sixty-three years. Eight were females. There was 1 example of bilateral meningoceles.

If untreated, the intrathoracic meningocele may increase in size. In 1 patient it occupied two-thirds of the hemithorax in five years. The treatment of choice is thoracotomy with extrapleural excision.

Four roentgenograms; 2 tables.

CHARLES M. NICE, JR., M.D.
University of Minnesota

Pneumomediastinum in Bronchial Cancer. A. Balmes and A. Thévenet. J. franç. de méd. et chir. thorac. **8**: 692–702, 1954. (In French)

The authors have used pneumomediastinum as a diagnostic procedure in bronchial cancer. One method consists of suprapubic injection of 1,800 to 2,000 c.c. of air into the space of Retzius with the patient supine. The air migrates through the retroperitoneal space to the mediastinum. The authors at present utilize the retro-xiphoid route of injection.

The procedure permits more accurate delineation of the primary tumor and of lymph node metastases by standard radiography and tomography, and information thus obtained aids in selecting patients for surgery. Of 10 patients examined by this technic, half were considered unsuitable for operation.

Eight roentgenograms.

CHARLES M. NICE, JR., M.D.
University of Minnesota

THE CARDIOVASCULAR SYSTEM

Cardioangiography. Philip W. Smith, Charles W. Wilson, Hugh A. Cregg, and Karl P. Klassen. J. Thoracic Surg. **28**: 273–280, September 1954.

The authors performed cardioangiography in 6 patients without mortality. Prior to this, 75 ventricular punctures were done in 18 dogs. A subxyphoid approach to the diaphragmatic surface of the heart was used, being considered preferable to an intercostal approach because of the possibility of laceration of a coronary vessel with the latter. Electrocardiograms were made before, during, and after the procedure, and the changes encountered are recorded.

From the animal experiments measures were developed to minimize the possible dangers of cardioangiography. The dangers and preventive measures are listed as follows:

1. Intramyocardial injection of contrast medium: Short-beveled needle with free backflow of blood.
2. Coronary vessel laceration: Single puncture of diaphragmatic surface of heart.
3. Myocardial ischemia: Rapid injection of limited quantity of contrast medium.
4. Ventricular fibrillation or cardiac arrest: Oronasal oxygen during procedure; continuous electrocardiography, with full preparation for cardiac resuscitation.
5. Perforation of another viscus: Decompression of stomach; proper direction of needle.
6. Cerebral or renal damage from contrast medium: Limited quantity of medium.

In the human cases, the procedure was accomplished under local anesthesia, with the injection of 20 c.c. of 70 per cent Diodrast into the ventricles through a 3 1/2-inch, 15-gauge, short-beveled needle. Continuous electrocardiographic tracings were made.

The puncture may be made either into the left or right ventricle. In one case ventricular fibrillation occurred, requiring cardiac massage. This was believed to be due to a prolonged injection, with displacement of the blood in the coronary arteries for too long a time. No other significant complications were observed.

The authors believe that this method affords improved delineation of the topography of the left side of the heart, the mitral valves, and the aortic valves, and that it may prove to be of value in the differential diagnosis of lesions of the heart and great vessels. Cardioangiography has not been attempted in children or in patients with cyanosis.

Four roentgenograms; 1 photograph; 5 tables.

R. G. FORTIER, M.D.
St. Paul, Minn.

The Value of Selective Angiocardiography in the Diagnosis of Complete Transposition of the Great Vessels. Åke Gyllenswärd and Herman Lodin. Acta radiol. **42**: 189–195, September 1954.

The authors present 2 cases of complete transposition of the great vessels not diagnosed correctly by intravenous angiocardiography. In 1 case additional selective angiocardiographic and catheterization studies (see Jönsson *et al.* Acta radiol. **32**: 486, 1949. Abst. in Radiology **55**: 616, 1950) were made, with injection of the contrast medium through the catheter. The right heart was filled through a catheter in the antecubital vein; the left heart by way of the saphenous vein. In this way correct assessment of the anatomic shunts was made.

The radiographic findings in complete transposition of the great vessels are discussed briefly.

Five roentgenograms.

ALBERT R. BENNETT, M.D.
Mt. Sinai Hospital, Cleveland

The Syndrome of Patent Ductus Arteriosus with Reversal of Flow. Daniel S. Lukas, Jorge Araujo, and Israel Steinberg. Am. J. Med. **17:** 298–310, September 1954.

Four cases of patent ductus arteriosus with reversal of blood flow are presented. The authors believe that the physiological and clinical features of these 4 cases and of 12 cases selected from the literature are characteristic enough to warrant the designation of a syndrome. Pulmonary arterial hypertension of sufficient magnitude to cause a shunting of venous blood from the pulmonary artery into the aorta (mainly the descending portion) is the physiologic basis of the condition. The hypertension is related to extensive arteriosclerotic and thrombotic alterations in the pulmonary vessels.

The usual clinical characteristics of uncomplicated patent ductus are absent. The continuous murmur is not heard and the pulmonary blood flow is small. Because of the distribution of the venous shunt there are cyanosis and clubbing of the toes. Cyanosis and clubbing of the fingers are absent or less pronounced. Right ventricular hypertrophy is evident in both the electrocardiogram and the roentgenogram. The main pulmonary artery and its branches are quite prominent. Pulsations of the pulmonary arteries are vigorous, but in only 1 of the cases reported were they of sufficient magnitude to be called hilar dance.

Angiocardiography is a valuable diagnostic tool in patent ductus with reversal of flow. In 3 of the authors' cases simultaneous opacification of the pulmonary artery, ductus, and descending aorta by the contrast agent provided vivid proof of the diagnosis. The examination was of particular importance in 1 case in which cyanosis of the upper as well as lower extremities was present and in which extensive clinical study and several cardiac catheterizations had failed to establish the diagnosis. Angiocardiographic study was similarly diagnostic in 5 of the 6 previously reported cases. Failure in 1 of these cases, as well as in 1 of the authors' patients, may have been due to absence of reversal of flow at the time of study.

For purposes of differential diagnosis, angiocardiography is very valuable, especially in patients with generalized cyanosis, in whom a misdiagnosis of Eisenmenger's complex is frequently made. In such patients the study aids in ruling out the presence of other lesions producing a venous shunt, in particular over-riding of aorta, patent foramen ovale associated with pulmonary hypertension, and aortic septal defect with reversal of flow. The procedure is also a reliable means for excluding the presence of a coexisting coarctation of the aorta with insertion of the ductus distal to the point of coarctation, for in this combination of lesions differential cyanosis between the upper and lower portions of the body may be present if a significant portion of blood supplying the aorta is derived from the ductus. Since there may be little or no difference between the blood pressures in the femoral and brachial arteries, angiocardiography may be the only method of detecting the coarctation.

Cardiac catheterization frequently reveals the diagnosis, is of aid in excluding coexisting anomalies, and provides information useful in deciding the proper treatment. Surgical experience in this condition is limited but indicates that ligation of the ductus is hazardous, though it may be followed by considerable decrease in the hypertension.

The mode of pathogenesis of the pulmonary vascular lesions is not known, but a large ductus capable of transmitting a very large left-right shunt early in the course of the disease is an essential factor. Polycythemia accentuates the venous shunt once it is established.

Three roentgenograms; 3 drawings; 1 diagram.

The Heart in Acute Glomerulonephritis. Timothy R. Murphy and Francis D. Murphy. Ann. Int. Med. **41:** 510–532, September 1954.

This report is a study of 88 cases of acute glomerulonephritis, with special attention to the heart. Cardiac involvement was believed to be present if one or more of the following criteria were present: (1) clinical heart failure; (2) cardiac changes on x-ray examination; (3) electrocardiographic abnormalities.

A diagnosis of cardiac failure was established in 22 of the 88 cases. In 18 of these, clinical heart failure was present on hospital admission but disappeared upon bed-rest and proper administration of fluids. In all cases improvement was accompanied by a fall in blood pressure.

There is no more acceptable evidence of cardiac involvement than the roentgen demonstration of enlargement. Teleroentgenograms were available in 29 of the 88 cases of this series. In 17 cases cardiac enlargement was found, associated in 10 cases with pulmonary congestion, in 3 with bilateral pleural effusion, and in 2 with right pleural effusion alone. In 8 patients, serial measurements of the cardiac area were made, by the method of Bardeen (Am. J. Anat. **23:** 423, 1918). Three determinations were done on each roentgenogram, with agreement within 1 per cent. In each instance the lowest cardiac area observed on the serial films was taken as the normal for the particular patient. In the majority of cases this was the last film. In 3 cases the maximal decrease in size occurred within the first week of hospitalization.

The incidence of electrocardiographic changes is of importance only as a reflection of the frequency of cardiac involvement. The possible mechanisms responsible for or contributory to the electrocardiographic changes are hypertension, alterations in the blood volume, electrolyte or toxic changes.

The relationship of cardiac enlargement to the electrocardiographic abnormalities was variable. Normal electrocardiograms were obtained both with and without cardiac enlargement. With clinical heart failure, x-ray examination showed enlargement in all cases.

Many causes have been considered in the pathogenesis of heart failure in acute nephritis. Chief among them is high blood pressure. In the 88 cases of acute nephritis studied, cardiac involvement was present in 41. Twenty-one of the 22 patients with heart failure had moderate or severe hypertension.

This study emphasizes the rapidity of the cardiac changes.

Seven roentgenograms; 1 electrocardiogram; 11 tables.

STEPHEN N. TAGER, M.D.
Evansville, Ind.

THE DIGESTIVE SYSTEM

Subacute Erosive ("Peptic") Esophagitis. Clinical Study of One Hundred Cases. Eddy D. Palmer. Arch. Int. Med. **94:** 364–374, September 1954.

This review of 100 cases of subacute erosive "peptic" esophagitis is concerned only with those cases in which

no specific etiologic factor could be discerned. Clinically it was felt that in these cases evidence pointed toward acid-peptic erosion secondary to reflux of the gastric juices through the cardia.

The esophageal endoscopic investigation was instituted because of upper abdominal or chest symptoms or upper gastrointestinal hemorrhage, or in a search for possible varices in association with cirrhosis.

Thirteen patients had subclinical esophagitis. The first symptom in another 11 cases was hematemesis, severe in 4 cases. Twenty-nine patients complained almost solely of dysphagia. Twenty-seven had burning or aching substernal pain, unrelated to deglutition. The remainder presented variable symptoms.

In the group studied roentgenologically, the diagnosis of esophagitis was made in only 6 instances. Carcinoma of the esophagus was suggested and disproved in 4 cases. On 3 occasions the esophagitis was misinterpreted as varices. On the other hand, the radiologic method proved more helpful than the endoscopic in elucidating the extent of secondary stricture formation and in detecting esophageal diverticula. Only 2 of 6 diverticula were recognized by esophagoscopy, in spite of the fact that they were known to be present.

Esophagoscopic findings were hyperemia, erosions, and exudate. The erosions were usually not more than 2 mm. in diameter and on numerous biopsies were found to extend only about two-thirds of the way through the epithelium.

A factor against the "peptic" or "regurgitant" theory is the occasional presence of achlorhydria. This was noted in 11 of 52 patients studied by gastric analysis. A further factor is the histopathologic picture found on biopsy. Consistently the submucosa shows the inflammatory infiltrate while the surface is normal except for the superficial erosions.

Three roentgenograms; 1 photograph.

RICHARD E. OTTOMAN, M.D.
University of California, L. A.

Spontaneous Rupture of the Esophagus. Tibor Bódi, Herbert Fanger, and Thomas Forsythe. Ann. Int. Med. **41**: 553–562, September 1954.

Spontaneous rupture of the esophagus, although rare, is a well established clinical entity. In order to study the mechanism by which this phenomenon is produced, the authors attempted to reproduce esophageal rupture by means of hydrostatic pressure applied intraluminally in the esophagus of cadavers. By means of a radiopaque suspension within the esophagus, it was possible to study the changes in the esophageal outline by fluoroscopy. Linear ruptures of the esophagus similar to those which occur spontaneously were consistently produced in the lower left lateral aspect.

A tube was inserted in the stomach and tied in place below the cardia, leaving the esophagus and chest intact. Although there was probably some weakening of the esophagus due to postmortem autolysis, the buttressing effect of the contiguous supporting structures was retained. Hydrostatic pressure was produced through the tube by application of oxygen under pressure against a barium suspension. Attached to the tank was a gauge which registered the applied pressure in pounds per square inch.

The clinical history in each case was carefully checked to rule out any disease of the stomach or esophagus. A mid-line incision was made on the cadaver to expose the stomach, which was then severed at the junction of the middle and upper third. The end of the tube was attached to the proximal stump by circular ties.

In a representative experiment, the esophagus of a 73-year-old female cadaver was ruptured three hours postmortem. When the contrast material was injected at a pressure of 1.5 pounds per square inch, the fluoroscope showed bulging of the lower end of the esophagus, just above the cardia. When the pressure was increased to 3.5 pounds per square inch, an increasing protrusion at the lower left lateral end of the esophagus was noted, followed by a sudden burst and spillage of the contrast material into the left pleural cavity. The lower left lateral bulge was of moderate size, and resembled in shape the herniation of mucosa between the separated muscle layers that has been described by others who have produced rupture of the esophagus by pneumatic and hydrostatic pressure. It is emphasized that no obstruction was applied to the esophagus, pharynx, or oral cavity. When the chest was opened, the entire amount of contrast material (1,500 c.c.) was found in the left pleural cavity. There was a linear rent in the left lower third of the esophagus, 3.2 cm. above the cardia, measuring 5.2 cm. in length and 0.3 cm. in width. The tear was exactly on the left posterolateral aspect of the esophagus, between the meso-esophagus and the left pulmonary ligament. The visceral pleura was intact.

In five experiments the pressure used varied between 3.5 and 6 pounds per square inch. The anatomic findings were similar in all five cases.

Hydrodynamic forces are accepted by most observers as responsible for spontaneous rupture of the esophagus. The development of excessive intraluminal pressure in the stomach may lead to a series of events, including increased secretion, general inhibition of motility of the gastrointestinal tract, and vomiting, which may result in esophageal rupture.

Anatomic features favor rupture in the lower segment of the esophagus. It is significant that here the muscle fibers terminate in a conical fashion, are tapering, and thinned out. In addition, inherent weakness is present at the site of the entrance of vessels and nerves into the musculature, and segmental defects are sometimes found in the circular muscle layer. The angulation between the abdominal and thoracic esophagus is also significant, since it may favor obstruction, with resultant increased intraluminal pressure.

Four roentgenograms; 1 photograph; 1 drawing.

STEPHEN N. TAGER, M.D.
Evansville, Ind.

Hiatal Anomalies and Cardial Reflux. Defective Development of the Cardia and Gastric Fornix. F. Robert and Th. Hoffmann. Fortschr. a. d. Geb. d. Röntgenstrahlen **81**: 255–270, September 1954. (In German)

According to the authors, a reflux of gastric contents into the esophagus (which is to be sharply distinguished from reflux into an intrathoracic segment of the stomach) is never encountered under normal conditions. It is suggestive of a developmental malarrangement of the cardia and cardial portion (fornix) of the stomach. Other findings characteristic of this type of anomaly are high insertion of the esophagus, a small gastric air bubble, gaping of the cardia, partial or complete absence of the normal angle between esophagus and stomach and, therefore, a straight transition from esophageal folds to the gastric rugae.

Fluoroscopy plays a primary role in revealing the reflux, because of its possible transient nature. Roentgenograms may fail to show it if the barium returns rapidly to the stomach. In chronic cases, the abnormality may cause reflux esophagitis with ulceration, stricture, and hemorrhage.

This condition simulates various degrees of hiatus hernia clinically, but may be distinguished roentgenologically by failure to demonstrate any part of the stomach in the thorax.

The authors observed 25 cases, 16 of which were operated upon. Two of the surgical cases are briefly described. In one, there was no recurrence two years after operation; in the other, a recurrence was present one year after surgical correction. Fifteen cases are summarized in tabular form.

Eleven roentgenograms; 2 drawings; 2 tables.

ERNEST KRAFT, M.D.
Newington, Conn.

Further Report on the Combination of Diverticula in the Gastrointestinal Tract with Hiatal Hernia. J. Smulewicz. Radiol. clin. **23:** 273–277, September 1954. (In German)

The author previously reported a case of combined hiatal hernia and diverticulum in the cardial region of the stomach (Radiol. clin. **22:** 469, 1953). At that time he could not be sure whether this was a purely fortuitous association or whether the combination formed a real syndrome, as no similar case had been encountered in the literature. He has since found 4 more cases.

The hiatal hernia in the first of the new cases was associated with a diverticulum in the lower third of the esophagus. A similar association was found in the second case, but the diverticulum was considerably smaller. The third case presented a double diverticulum in the middle portion of the esophagus along with the hiatal hernia. In the fourth case the diverticulum, the size of a walnut, arose in the distal part of the ascending colon.

These 4 cases of hiatal hernia and diverticula, encountered within fourteen months in a small practice, suggest that the two conditions are related. All of the patients were between forty-four and sixty-eight years old, and in all the subcutaneous fat was poorly developed. The author believes that his series of cases represents a constitutionally determined weakness of the musculature of the diaphragm and of the wall of the gastrointestinal tract. Weakening of the musculature and disappearance of fatty tissue are part of the aging process, and both favor the development of diverticula and hiatal hernia.

Five roentgenograms.

CHRISTIAN V. CIMMINO, M.D.
Fredericksburg, Va.

Visualization of Gastric and Lower Esophageal Veins by Splenoportography in a Case of Carcinoma of the Lesser Curvature. D. Catalano and S. Riccio. Ann. radiol. diag. **27:** 233–236, May–June 1954. (In Italian)

A case of ulcerated gastric carcinoma is reported in which splenography was performed to demonstrate localization of obstruction in the portal system. The patient was a 45-year-old male with ascites, collateral circulation on the anterior abdominal wall (flanks), and a large, smooth liver. Splenography revealed an interesting pattern of the deep collateral branches of the splenic vein, which is reported in detail. The contrast medium introduced into the spleen did not appear in the splenic and portal veins but was promptly observed in a network of veins which almost anatomically delineated the shape of the fundus and upper third of the stomach. Two well defined veins originating at the cranial end of the lesser curvature were also well visualized; they were parallel to each other and followed a straight course along the spine up to the body of the 8th thoracic vertebra. These were the inferior esophageal veins.

Subsequent pictures, taken at various intervals after the injection of the opaque medium, revealed the presence of a rather short, large venous channel representing the intermediate segment of the splenic vein and connected with the splenic hilus by many thin vessels.

In the tumor area (lesser curvature) the venous pattern was represented by irregularly distributed, thin, serpiginous vessels, while the usual gastric venous network was barely recognizable.

[Extrinsic compression or thrombosis of the splenic vein causes this pattern of collateral circulation between spleen, stomach, and esophagus. Its demonstration through splenography may sometimes be of practical value—R.G.O.]

Three roentgenograms.

R. G. OLIVETTI, M.D.
Newington, Conn.

The Adverse Effects of Belladonna Alkaloids in Benign Pyloric Obstruction. An Experimental Study. Philip Kramer. New England J. Med. **251:** 600–605, Oct. 7, 1954.

The author has studied the effects of belladonna alkaloids in benign pyloric obstruction in an attempt to evaluate the rationale for the common use of these substances in this condition.

Fifteen patients with pyloric obstruction complicating chronic peptic ulcer were studied by means of a barium-radiographic technic. In 9 patients the drugs produced increased gastric retention. In 4 of the 9, complete retention was seen at five hours. The results obtained appeared to be due to decreased gastric tone and peristalsis.

These findings and clinical observations indicate that antispasmodics may aggravate pyloric obstruction in some patients. It is suggested, therefore, that belladonna alkaloids be used cautiously in patients with benign pyloric obstruction and discontinued if there is failure to improve.

Three roentgenograms; 2 tables.

THEODORE E. KEATS, M.D.
University of California, S. F.

Two Cases of Gastro-Gastric Intussusception. Clerio Di Carlo. Radiol. med. (Milan) **40:** 865–872, September 1954. (In Italian)

Gastro-gastric intussusception is rare. It may be either descending or retrograde. Rigidity of a gastric segment, either from neoplasm or indurated ulcer, is a factor in most of the cases. The clinical diagnosis is difficult because of the symptoms of the underlying disease. The intussusception may result in either partial or complete obstruction. At times a mass is palpable in the upper abdomen. The author describes two cases.

The first patient, aged 42, showed a sharply demarcated filling defect in the antrum, with the concavity directed proximally. The contrast in the center of this concavity represented a patent lumen. The over-

hanging edges peripheral to the concavity formed a sort of ring around the defect proximally. The contours showed slight changes during examination. Compression films demonstrated a prepyloric ulcer. Active peristalsis ended at the filling defect. Emptying of the stomach was moderately retarded. Surgery disclosed a large benign ulcer.

The second patient, 60 years of age, had a deformity in the inferior third of the stomach and an annular filling defect with overhanging edges proximally. While the defect was constant, it changed its shape with degrees of filling. Peristalsis ended at the filling defect. Emptying was moderately retarded. Surgery demonstrated a large scarred ulcer on the lesser curvature, with much induration of the wall.

Six roentgenograms.

CHRISTIAN V. CIMMINO, M.D.
Fredericksburg, Va.

A Suggestive X-Ray Sign of Strangulation in Intestinal Obstruction. Frank J. Rack and Norman Glazer. Arch. Surg. **69**: 233–241, August 1954.

The authors draw attention to a roentgen finding in strangulated small intestinal ileus which appears in the supine abdominal roentgenogram. This consists of a localized shadow or haze with a ground-glass appearance, sometimes with edges which appear scalloped. It is caused by the fluid-filled decompensated loops of bowel lying upon one another. The seeping of fluid through the wall of the bowel causes loss of delineation between the loops and gives the appearance of a mass. Other signs of obstruction, such as gas distention of loops above the strangulated area, may or may not be present.

Eight cases are reported to illustrate this sign. The differentiation between simple and strangulating obstruction is largely clinical, but the presence of this finding, say the authors, gives strong support to a diagnosis of strangulation.

Twenty illustrations, including 9 roentgenograms.

D. D. ROSENFELD, M.D.
Oakland, Calif.

Obstruction of the Small Intestine in Infants and Children. A Roentgenologic and Pathologic Study. Richard M. Craig, John R. Hodgson, and Malcolm B. Dockerty. Am. J. Roentgenol. **72**: 412–425, September 1954.

This study concerns acute obstruction of the small intestine occurring in infants and children up to fifteen years of age. Until recently, interest in obstruction of the small intestine in this age group was limited to a study of the pathology. With advances in pediatric surgery and roentgenology, emphasis has shifted to early diagnosis and treatment. Careful and accurate analysis of the roentgenogram of the abdomen has proved a valuable method of early diagnosis in these cases.

Records of 66 cases in children up to the age of fifteen, seen between the years 1942 and 1951, were reviewed. Among the 66 cases there were 24 deaths. Almost two-thirds of all the obstructions were secondary to incomplete intestinal rotation or to adhesions. Abdominal roentgenograms, reviewed in 37 of the 66 cases, revealed intestinal obstruction in all but 1 instance. In 27 cases the obstruction occurred in the first six weeks of life. There were approximately as many cases in infants in the first week of life as there were in children from one to five years of age.

The type of obstruction is classified in two groups: "intrinsic obstruction," which includes congenital obstruction due to atresia or stenosis, and "extrinsic obstruction," which is related to embryologic aspects of intestinal rotation.

Atresia is more common than stenosis and occurs most frequently in the ileum and duodenum. More than half of the stenoses are found in the duodenum. The incidence of these obstructions is 1 in 20,000 births; obstruction is multiple in 15 to 25 per cent of cases.

There were 23 cases of extrinsic obstruction occurring in 22 patients. Volvulus occurred 12 times in the 23 cases; interference with the blood supply in only 2 cases. A roentgenographic diagnosis of obstruction was obtained in all cases in which a preoperative roentgenogram was available for study.

Meconium ileus, Meckel's diverticulum, adhesions, cysts and tumors, infections and foreign bodies are also discussed in their role of producing obstruction of the small intestine.

There are two findings on the roentgenogram of the abdomen which suggest early obstruction of the small intestine. The first consists of sharp turns of intestine dilated with air. The other is increasing accumulation of air as seen on serial roentgenograms. Numerous conditions other than intestinal stasis may, however, produce air-fluid levels on the abdominal roentgenogram. For this reason, a diagnosis of intestinal obstruction must always be supported by positive clinical findings. When the diagnosis is in doubt, serial roentgenograms will frequently settle the issue.

Six roentgenograms; 3 photographs; 6 tables.

JOSEPH P. TOMSULA, M.D.
Baton Rouge, La.

Roentgen Studies of the Small Intestine in Sprue. Richard H. Marshak, Bernard S. Wolf, and David Adlersberg. Am. J. Roentgenol. **72**: 380–400, September 1954.

The authors report a study of the small intestine in a group of 40 patients with sprue who were followed from one to seventeen years, in an attempt to learn if a characteristic alteration pattern can be identified. The effect of antianemic and steroid therapy on the roentgen findings is included.

The basic etiology of sprue is unknown, although a number of theories have been proposed. At present, the concept prevails that sprue is a deficiency syndrome, causing or caused by disturbed intestinal absorption.

Three patients revealed a normal small intestinal pattern. The remainder exhibited two distinctive patterns. The first and most characteristic was observed in 70 per cent of the patients in this series and consists of dilatation most prominent in the mid- and distal jejunum, segmentation, large barium-filled loops of ileum best visualized during the evacuation of the barium meal, thickening of the mucosal folds, and the presence of hypersecretion of an altered quality. While each of these features may occur in a wide variety of disorders, they are more frequent in and more pronounced in sprue. In the second pattern, segmentation is marked, early, and persistent, and is present throughout the small intestine, secretions are pronounced and dilatation is slight to moderate. This latter pattern occurred in only 10 per cent of the patients in this series. It is also observed on occasion in those conditions and

diseases simulating sprue, namely, nephrosis, hyperthyroidism, cirrhosis, pancreatic steatorrhea, pellagra and other deficiency states. Differential diagnosis includes, also, ileojejunitis, lymphosarcoma, tuberculosis, scleroderma and amyloidosis.

Roentgen evidence of improvement in the sprue pattern was significant in 3 patients following steroid therapy and in 4 patients who for many years had received antianemic therapy.

The "sprue pattern" is sufficiently distinctive roentgenologically to separate it from the heterogeneous group of conditions heretofore labeled with the roentgen diagnosis of "irritation pattern," "enteropathy in deficiency states," "deficiency pattern," or "disordered motor function."

Twenty-five roentgenograms.

JOSEPH P. TOMSULA, M.D.
Baton Rouge, La.

Roentgen Studies of the Effects on the Small Intestine from Emotional Disturbances. Jack Friedman. Am. J. Roentgenol. **72:** 367–379, September 1954.

Physiological variations existing during gastrointestinal examinations with barium make it important that they be recognized by radiologists. The term "disordered motor function" is used to describe the various changes which occur. Among these are hypomotility or hypermotility, segmentation, clumping of the barium, coarse flocculation of the barium, coarsening and widening of the mucosal folds, and variably distended and contracted loops of small intestine.

The author conducted a clinical experiment to determine the effect of emotional factors in the production of such changes. A small intestinal study was done with plain barium sulfate in water. After the recording of a normal mucosal pattern, an attempt was made by interview technic to alter the mood of the patient, producing such emotional states as anger, fear, frustration, and self pity. Four cases are reported to illustrate the alterations in the mucosal pattern under these conditions. The results demonstrated that emotional distress can induce an altered mucosal pattern in the small intestine and that it is not necessary for the patient to be deficient in foodstuffs or chemicals, nor to be the victim of other diseases.

Sixteen roentgenograms; 1 table.

JOSEPH P. TOMSULA, M.D.
Baton Rouge, La.

Amyloidosis of the Small Intestine. Ross Golden. Am. J. Roentgenol. **72:** 401–408, September 1954.

Amyloid is a protein material which exhibits certain chemical reactions resembling those of starch. Amyloidosis is the term applied to the presence of this substance in various organs or tissues in the human body.

Amyloidosis is usually divided into two groups, primary and secondary. In the latter, the deposits of amyloid occur in association with other diseases, such as chronic infections, leukemia, Hodgkin's disease, myeloma, etc. Primary amyloidosis occurs without relation to other diseases; its cause has not been determined. In either primary or secondary amyloidosis, fatal interference with some vital function eventually occurs.

The author reviews 3 cases of amyloidosis, with roentgenograms demonstrating abnormalities of the small intestine. Either primary or secondary amyloidosis may cause: (1) thickening of the mucosal folds of the intestine when the mucosa is infiltrated, (2) narrowing and irregularity of the lumen, roughly simulating the effect of chronic inflammation, such as regional enteritis, (3) gas distention when the tunica muscularis is sufficiently replaced, simulating ileus, either mechanical or paralytic, and (4) slowing of the transit time. Gas distention seems to be the most common abnormality in either primary or secondary small intestinal amyloidosis

Eight roentgenograms; 4 photomicrographs.

JOSEPH P. TOMSULA, M.D.
Baton Rouge, La.

Malignant Duodenal Colic Fistula. A Case Report. Bruce T. Colwell. J. Canad. A. Radiologists **5:** 33–35, September 1954.

Malignant duodenocolic fistula is quite uncommon. The case reported here is the twenty-second in the literature available to the author, and the fourth occurring in a female. The patient was admitted to the hospital complaining of diarrhea with weight loss and abdominal cramps, of several months duration. On x-ray examination of the upper gastrointestinal tract, the barium was seen to fill the second portion of the duodenum and then to pass into the hepatic flexure of the colon, the cecum, and ascending colon. None could be seen going into the jejunum. Within half an hour the barium had reached the rectum *via* the short circuit.

Examination by barium enema showed a free flow of barium from the hepatic flexure through the fistulous tract into the second portion of the duodenum and back into the stomach. The barium in the stomach then passed through the duodenal loop into the jejunum.

At operation, a large mass was found in the region of the hepatic flexure, firmly adherent to the second portion of the duodenum and the pancreas. This proved to be a well differentiated adenocarcinoma.

This patient demonstrated the characteristic clinical picture of malignant duodenocolic fistula, namely persistent severe diarrhea, marked weight loss and weakness, abdominal distress, undigested food and occult blood in the feces, hypoproteinemia and disturbed food absorption as shown, for example, in the plasma protein level and anemia.

Two roentgenograms.

ALFRED O. MILLER, M.D.
Louisville, Ky.

Study of the Sigmoid by Special Roentgenographic Views. Alice Ettinger and Milton Elkin. Am. J. Roentgenol. **72:** 199–208, August 1954.

Because of the multicoiled nature of the sigmoid, a completely satisfactory examination may be difficult to accomplish. The authors review the methods available to the radiologist for more adequate study of the rectosigmoid and sigmoid and present 7 cases to illustrate the various technics.

It is generally agreed that careful rotation of the patient during slow filling of the colon at fluoroscopy, to allow observation of the head of the barium column at all times before the loops are superimposed, is the best method of roentgen investigation of the rectosigmoid and sigmoid. Since the routine anteroposterior and postero-anterior views are not usually adequate, special views are described to uncoil these parts of the colon. The true lateral view has been advocated for the study of the rectum and the pelvic portion of the sigmoid.

Oblique views have been used to separate the sigmoid coils, the degree and direction of the obliquity being determined at the time of fluoroscopy. Air contrast studies, especially with stereoscopic films, will often improve visualization. The supine Trendelenburg position may allow the sigmoid to fall partially into the false pelvis, with separation of some of the loops. Stewart and Illick (Am. J. Roentgenol. **28:** 379, 1932) suggested that distention of the urinary bladder would be useful in some cases. Raap (South. M. J. **44:** 95, 1951. Abst. in Radiology **58:** 154, 1952) has made use of the Chassard-Lapiné position commonly employed for pelvimetry, with the film at right angles to the anteroposterior plane of the pelvis and the central ray directed through the spine and sacrum. He stated that inasmuch as the folding and overlapping of the coils of bowel occur in a horizontal plane, a projection at right angles to the usual angle should be of value; it especially allows a study of the anterior and posterior surfaces of such coils. This projection may be used with the colon empty or full, in barium enema or air studies.

The authors realize that it is not feasible to attempt all the suggested projections in every roentgen study of the colon. The mainstay of the barium enema examination is careful fluoroscopy, spot-filming, and pre- and postevacuation films. In addition, it is advisable to obtain a record of the sigmoid loop by an oblique or lateral view of this area during filling. There are difficult cases, however, where more effort may be expended, as in very obese patients and patients with a redundant sigmoid in whom a neoplasm of the colon is suspected clinically and routine examination has failed to show a lesion.

Twenty roentgenograms; 2 photographs.

DANIEL WILNER, M.D.
Atlantic City, N. J.

Correlation of the Clinical, Pathological and Roentgenological Findings in Diverticulitis. Alexander Goulard, Jr., and Aubrey O. Hampton. Am. J. Roentgenol. **72:** 213–221, August 1954.

The authors describe the clinical, pathological, and roentgen findings in acute and chronic diverticulitis of the colon with particular emphasis on roentgenologic differentiation. Of 158 patients in whom a roentgen diagnosis of diverticulitis was made, 70 were admitted to the hospital, but in only 35 of this number was there considered to be sufficient evidence (history, various types of examination, and course of the disease) to justify a diagnosis of acute diverticulitis. Because of this discrepancy, the usual criteria for diagnosis are reviewed, as follows:

(1) *Demonstration of diverticula:* Occasionally, in acute diverticulitis, the diverticula may not be demonstrated. In 6 of the 35 cases in this series, the diverticula were not filled on the initial film. In 3 instances they were demonstrated on later barium examination.

(2) *Serrated or "saw tooth" deformity:* Serrations of the distended colon represent narrow spaces between approximated folds. The basic pathologic change is fibrotic shortening of the bowel, with thickening of the folds. Serrations are permanent and indicative of previous inflammation, as is illustrated by the fact that 10 patients had no change in the deformity at intervals of three months to three years, though in 6 there were asymptomatic intervals.

(3) *Spasm:* Pathologic spasm is defined as a state of contraction which is persistent during any one examination. It was observed fluoroscopically in only 15 of the 35 cases and on the roentgenogram in only 22.

(4) *Tenderness:* There are two findings which the authors feel are indicative of acute disease, namely, localized tenderness and the demonstration of abscesses. In the presence of fibrotic shortening of the bowel, with or without diverticula, tenderness with accurate localization may be the only clue to an acute exacerbation.

(5) *Abscess formation:* It has been stated that perforation of a diverticulum with abscess formation is rare. The authors believe that the case is exactly the reverse, and that acute diverticulitis results from a perforated diverticulum with cellulitis and abscess formation, even though the abscess may be quite small. By utilizing studies in various views, abscesses were demonstrated by x-ray in 60 per cent of their 35 cases, ranging from 1.5 to 4 cm. in diameter. These abscesses may be manifested as tender extramucosal defects with an intact overlying mucosal surface and fading margins in profile. In 8 instances, the abscesses were demonstrated by filling them with barium.

Twelve roentgenograms; 2 photographs.

DANIEL WILNER, M.D.
Atlantic City, N. J.

Actinomycotic Diverticuloma of the Sigmoid Colon. Harry S. Hoffman. J.A.M.A. **156:** 244–246, Sept. 18, 1954.

Actinomycosis in the sigmoid colon is rare, this case report being the seventh in the literature. In none was a correct diagnosis made preoperatively. In 4 instances masses were removed under the impression of a malignant lesion. This is the first reported case of an actinomycotic diverticuloma. The preoperative diagnosis was diverticulitis with abscess formation and/or neoplasm.

Actinomycotic lesions of the colon usually involve the muscular and serosal coats, leaving an intact mucosa.

Two roentgenograms.

JOHN P. FOTOPOULOS, M.D.
University of Michigan

Detorsion of Volvulus of the Right Colon. Roentgenographic Considerations. Leo S. Figiel and Steven J. Figiel. Am. J. Roentgenol. **72:** 192–198, August 1954.

The authors have observed 3 cases of volvulus of the cecum and ascending colon in which detorsion was demonstrated roentgenographically. In 2 instances, detorsion occurred at the time of a colonic examination by barium enema study. In the third case, volvulus occurred as a postpartum complication and detorsion was effected by placement of the patient in the knee-chest position.

One may encounter volvulus of the cecum and ascending colon with complete or partial obstruction. The abnormally rotated colonic segment may retain its usual location or it may become displaced to a more or less ectopic position within the abdomen. Most often the combination of complete obstruction with displacement of the cecum to an ectopic position prevails. In such cases, the roentgen features are quite characteristic and diagnosis of volvulus is a fairly simple procedure.

Demonstration of an abnormally dilated intestinal segment, possibly colonic, often identifiable as cecum, in proximity to the apparent proximal termination of the right colon during the course of barium enema

study should immediately suggest that the cecum may not have been filled, and may be obstructed. Abnormal disposition of the cecum (distended gas pocket) in the presence of obstruction, demonstrated on the barium enema study, must force one to consider seriously the possibility of torsion effects.

Nine roentgenograms.

DANIEL WILNER, M.D.
Atlantic City, N. J.

Progress in the Roentgenologic Demonstration of the Gallbladder. E. Gaebel and W. Teschendorf. Fortschr. a. d. Geb. d. Röntgenstrahlen **81:** 296–313, September 1954. (In German)

Considerable progress in oral cholecystography and cholangiography has been made in recent years with the introduction of Telepaque and Teridax. Of special interest is a report on intravenous cholecystography and cholangiography with Biligrafin (introduced in United States as Cholografin), which contains six atoms of iodine per molecule or twice as much as Telepaque and Teridax. The ordinary Biligrafin is a 20 per cent sodium salt and Biligrafin forte a 40 per cent lithium salt.

With this new medium the gallbladder and bile ducts show optimal density. The gallbladder is visualized as early as two hours after injection and the bile ducts within twenty minutes. When the drug is injected slowly, over a period of five minutes with frequent interruptions, reactions may not occur. Nausea may follow too rapid injection without interruption. For gallbladder visualization, a dose of 20 c.c. is sufficient; for demonstration of the bile ducts in postcholecystectomy cases 40 c.c. of ordinary Biligrafin or 20 c.c. of Biligrafin forte is necessary. Practically all of the drug is excreted by the liver; only in hepatic block does the urinary tract take over, in which case the kidney pelves and calyces become visible.

The gallbladder was visualized in 165 of 245 cases following failure of the oral method. Principal causes of failure with the intravenous method are hepatic insufficiency, closure of the cystic duct and gallbladder neck, chronic cholecystitis with shrinkage of the gallbladder, and kinking of the gallbladder neck or cystic duct, with adhesions.

Bile ducts were seen in 300 out of 305 cases; duct stones were discovered in 74 cases and other duct changes in 78 cases.

The main advantage of Biligrafin lies in visualization of the bile ducts, especially in postcholecystectomy cases. In such cases the ducts failed to fill only when under marked pressure, with biliary congestion secondary to an obstructing tumor or impacted calculus.

Of further value was retrograde filling of the duodenal bulb with Biligrafin. Adhesions could also be demonstrated in combination with pneumoperitoneum. Tumors of Vater's papilla were observed, as well as dyskinesia of the bile ducts with a spastic sphincter of Oddi—so-called odditis. In this latter condition the common duct points sharply downward and assumes a "comma" shape.

Twenty-six roentgenograms.

ERNEST KRAFT, M.D.
Newington, Conn.

The Accuracy of X-Ray Examination of the Gallbladder. Howard Mauthe. Wisconsin M. J. **53:** 473–476, September 1954.

In a series of 110 cases in which cholecystectomy was performed, cholecystography was found to have an accuracy of 95.5 per cent. In 2 cases a normal gallbladder appeared abnormal on the roentgenogram, and 3 abnormal gallbladders were diagnosed as normal. The author believes that with present methods the 2 normal gallbladders would have been recognized as such. In two of the other erroneous diagnoses, the pathologic changes were minimal.

The author now uses six tablets of Telepaque and follows the ingestion of the pills with castor oil five hours later. No fatty meal is given, since visualization of the gallbladder is proof of function and compression radiography obviates the danger of too dense concentration. "Non-functioning gallbladders" are re-examined before being termed pathological.

Only three results are recognized: (1) normally functioning gallbladder with no evidence of stone; (2) normally functioning gallbladder containing non-opaque (or partially calcified) stones; (3) non-visualization of the gallbladder (with or without the presence of partially calcified gallstones). Other classifications such as "poorly functioning gallbladder," "questionable visualization of the gallbladder," etc., are avoided.

In view of the high degree of accuracy of the method, cholecystectomy in a patient with a normal cholecystogram is considered unjustified.

PAUL MASSIK, M.D.
Quincy, Mass.

Ascariasis of the Biliary Tract: Radiologic Demonstration by Barium Reflux. S. Gasparini and C. Meneghini. Radiol. med. (Milan) **40:** 890-895, September 1954. (In Italian)

In a 59-year-old patient, a gastrointestinal series demonstrated reflux of barium from the intestine into the biliary tract through the sphincter of Oddi, whose function was thought to be modified by the presence of a small vaterian diverticulum. A large ascaris was clearly outlined in the common duct by the barium. Slight change in position on serial studies showed it to be living. No identical case was found in the literature.

One roentgenogram; 1 drawing.

CHRISTIAN V. CIMMINO, M.D.
Fredericksburg, Va.

Operative Cholangiography. E. S. R. Hughes and R. H. Kernutt. Brit. M. J. **2:** 620–623, Sept. 11, 1954.

The authors distinguish between two types of operative cholangiography: (1) diagnostic operative cholangiography that is performed before dissection of the biliary tract is begun; (2) control operative cholangiography, performed after exploration of the common bile duct, to determine whether all stones have been removed.

The results of these procedures in a series of 50 patients are summarized. In 32 instances the diagnostic cholangiogram was normal and no exploration was made. In 12 cases, stones were visualized as filling defects and were removed. In 3 cases, none of the medium entered the duodenum, and in 2 of these, stones were removed from the common bile duct. In 13 of the 14 instances in which stones were found, indications for opening the common bile duct were present even before cholangiography confirmed the diagnosis. In 3 further cases, the diagnostic cholangiogram appeared abnormal, but no stones were found on exploration. For these reasons, the authors were disappointed with diagnostic operative cholangiography as a routine procedure.

Control operative cholangiography they consider to be much more useful: in 1 of the 10 cases in which it was performed, a stone that had been overlooked was discovered and the duct was re-explored.

Two roentgenograms. JOHN J. CRAVEN, M.D.
Cleveland Clinic

Extension of Immediate Cholangiography in Common Duct Surgery. John Armes Gius, Robert T. Tidrick, and Robert C. Hickey. Surgery **36**: 460–467, September 1954.

A technic of operative cholangiography differing from the conventional method in the following respects is described: (*a*) The position of the patient on the operating table is reversed so that the gallbladder area lies over an aperture between the body and footpiece of the table. (*b*) The portal x-ray machine is placed at what is now the head of the table, beneath the aperture, and directed upward. (*c*) Multiple exposures are made, if necessary, on two types of film, a small film placed over the duodenum and a large film over the abdomen. This technic obviates movement of the x-ray unit during operation, eliminates interference with the operation, decreases the risk of bacterial contamination, and provides roentgenograms of unusual clarity.

From an investigation of the factors which influence roentgenologic visualization of the common duct, the authors conclude: (*a*) Diodrast 35 per cent is the contrast medium of choice. Media of higher density tend to obscure small stones. (*b*) Injection of medium in small amounts and without pressure sufficient to distend the duct system provides optimal demonstration of calculi, whereas large amounts of medium and/or distention decrease visualization. (*c*) As the size of the common duct stone approaches the size of the duct, the chances of detecting the stone are increased. Packing of stones exerts a similar influence. (*d*) Air bubbles are often difficult or impossible to differentiate from calculi; they should be excluded from the system. (*e*) The possibility that the density of common duct stones may approach the density of the radiopaque medium appears more theoretical than real.

The extension of the use of operating room cholangiography, particularly to obstructive jaundice in the newborn, appears rewarding. In 7 consecutive patients the authors have used methylene blue diluted with Diodrast 35 per cent to achieve both direct and radiographic visualization of the ducts. With the combined procedures, the surgeon is able to assay the anatomic aberrations within the duct system. The cholangiogram provides documentary evidence of the situation and minimizes the possibility of overlooking a remediable condition.

Five roentgenograms; 1 photograph.

Operative Cholangiography as an Aid in Surgery for Jaundice. Stanley O. Hoerr. Arch. Surg. **69**: 432–441, September 1954.

Cholangiography during surgery may be of great assistance in the jaundiced patient to determine the location and character of an obstruction or to demonstrate normal extrahepatic bile ducts, indicating that the jaundice is of hepatic origin. Eleven cases are briefly reported to illustrate different conditions.

(1) Jaundice of Hepatic Origin: The cholangiogram is normal.

(2) Benign Strictures: Injection of contrast medium into the distended proximal end of the common duct will establish the distance between the obstruction and the bifurcation of the right and left hepatic ducts, helping the surgeon plan his reconstruction. It is even more valuable for demonstrating an intrahepatic stricture which might otherwise escape detection.

(3) Obstruction of the Sphincter of Oddi: This may be due to fibrosis, chronic pancreatitis, or tumor.

(4) Obstruction by Extrinsic Malignant Disease: A cholangiogram may be useful, if the lesion is not resectable, in planning a shunt around the obstruction.

(5) Common Duct Calculi: Routine operative cholangiography may be regarded as a preventive measure against future obstruction and jaundice due to unsuspected stones in the common duct.

(6) Miscellaneous Conditions: Routine cholangiography may demonstrate an unsuspected condition. In a case reported by the author it revealed complete division of the common duct as the result of a previous operation.

The technic of examination varies, but generally an aqueous soluble iodine preparation (of the type used for intravenous pyelography) is employed. Injection may be made into a duct or into the gallbladder itself.

Nineteen roentgenograms; 1 photograph; 1 drawing.
PAUL MASSIK, M.D.
Quincy, Mass.

Intravenous Cholangiography. A Preliminary Study. A. L. L. Bell, Lewis L. Immerman, Joseph P. Arcomano, Jerome Zwanger, and Edward T. Bello. Am. J. Surg. **88**: 248–253, August 1954.

The authors describe their experience with intravenous cholangiography, using Cholografin, introduced in Germany as Biligrafin. Ninety per cent of the compound enters the liver from the blood stream, concentrates in the biliary tree, and empties into the intestine. None is re-absorbed from the gastrointestinal tract. The solution, which is almost isotonic, is packaged in 20 c.c. ampules. After preliminary tests for sensitivity, one ampule is injected intravenously over a five- to ten-minute period. Films are obtained at ten-minute intervals until maximum concentration is obtained. In the cases presented, this occurred between forty and sixty-five minutes for visualization of the common duct. For the one case in which the medium was used for gallbladder visualization, this appeared best in two and a quarter hours.

The procedure is especially suited for study of postcholcystectomy cases but also provides valuable information where oral cholecystography fails to give visualization or where multiple gallstones are suspected.

Cholografin was used in 10 cases, 7 of which showed good concentration in the duct system. In 2 cases common duct calculi were shown. Only 1 patient showed an unfavorable reaction to the medium.

Eleven roentgenograms. D. D. ROSENFELD, M.D.
Oakland, Calif.

THE DIAPHRAGM; HERNIA

Deformity of the Left Hemidiaphragm from a Retothelial Sarcoma of the Spleen. Mario Rossetti. Radiol. clin. **23**: 281–282, September 1954. (In German)

The author reports the case of a seventy-five-year-old man with multiple peripheral lymph node swellings. A biopsy disclosed retothelial sarcoma. Roentgen

examination showed a sharply outlined hump in the mediodorsal portion of the normally moving left hemidiaphragm. The gastrointestinal series revealed unexpectedly marked splenomegaly, with ventral displacement of the upper portion of the stomach and indentation of the greater curvature. The upper pole of the spleen was shown to be the cause of the diaphragmatic deformity.

This case is reported because of the atypical splenomegaly presenting as a diaphragmatic deformity, a situation which could be of differential diagnostic importance in abnormalities of the thorax. It is suggested that the enlargement proceeded craniomedially because of an accompanying perisplenitis. Ordinarily the spleen enlarges caudad and may even be found in the pelvis. This diaphragmatic indentation by the spleen is all the more unusual because the muscle fibers in this portion of the diaphragm are strong.

[The abstracter has recently seen a case very similar to this, but the dorsomedial defect was proved to be caused by an old traumatic herniation of the spleen through the diaphragm. Ectopic kidney should also be included among the differential diagnoses.—C.V.C.]

Two roentgenograms.

CHRISTIAN V. CIMMINO, M.D.
Fredericksburg, Va.

Roentgenologic Demonstration and Analysis of the Diaphragm and of the Esophageal Foramen. J. Eberl. Fortschr. a. d. Geb. d. Röntgenstrahlen **81**: 270–275, September 1954. (In German)

The exact localization of the esophageal foramen is rather difficult even with the aid of barium in the stomach and esophagus. On the other hand, such localization is important so that one may decide whether a given object is above or below the diaphragm. Routine films will lead to proper identification if critically analyzed, although on first glance they can be confusing.

The esophageal foramen or hiatus is usually located somewhat behind and below the dome of the diaphragm, and not at the point where the esophagus crosses the contour of the diaphragm. In the majority of cases the hiatus is either higher or lower than the crossing point, and the proper orientation depends on whether the dome or the descending portion of the diaphragm is depicted.

In the prone position the anterior portion of the diaphragm is projected in an upward direction and the remaining part is further removed from the posterior chest wall than in the supine and erect posture. The supine view is best for localizing the hiatus; on the prone view a portion of the stomach may simulate a supradiaphragmatic position in obese subjects. In these the stomach has an upward convex course and crosses the esophagus almost at a right angle. Thus, a hernia or even a volvulus may be simulated. This illusion is explained by the fact that the anterior portion of the diaphragm is displaced in an upward direction and that the stomach is crowded against the undersurface.

Five roentgenograms; 6 drawings.

ERNEST KRAFT, M.D.
Newington, Conn.

Contribution to the Roentgenology of Hiatus Hernia and Hiatus Insufficiency. Hans R. Beck. Fortschr. a. d. Geb. d. Röntgenstrahlen **81**: 276–283, September 1954. (In German)

In recent years the following three types of hiatus hernia have been described: (1) congenital type with short esophagus, (2) paraesophageal type, and (3) axial type with tortuous esophagus. The term "hiatus insufficiency," on the other hand, has been used to designate a temporary sliding or slight prolapse of the cardiac portion of the stomach without participation of the peritoneum. The author does not agree with this classification and believes that the size of the hernia is not a valid criterion and that the peritoneum cannot be recognized roentgenologically. He would reserve the term "hiatus hernia" for the congenital type with short esophagus—a rare form—and group the acquired types under the designation "hiatus insufficiency," with three subdivisions: (1) simple hiatus insufficiency, (2) hiatus insufficiency with axial hernia, and (3) hiatus insufficiency with paraesophageal hernia.

Fourteen cases of hiatus insufficiency were observed in the course of a year (1.14 per cent of a total of 1,230 gastric examinations), including 9 of simple hiatus insufficiency, 3 of paraesophageal hernia, and 2 of axial hernia.

As a differential diagnostic possibility one has to consider diverticulum of the lower esophagus. This is, however, a rare condition which can be excluded without difficulty, as it can always be clearly seen, even in the erect posture.

Eleven roentgenograms.

S. W. WESTING, M.D.
Newington, Conn.

Congenital Diaphragmatic Hernia. William L. Riker. Arch Surg. **69**: 291–306, September 1954.

On the basis of a series of 33 cases, the author discusses the five types of congenital diaphragmatic hernia and presents illustrative examples.

Congenitally Short Esophagus (1 case): In this abnormality, there is incomplete descent of the stomach before the lumbar portion of the diaphragm is complete, so that the esophagus remains short, with a portion of the stomach in the thoracic cavity. The diagnosis is made by x-ray studies with a barium or iodized oil swallow and confirmed by esophagoscopy. Complications are mucosal ulceration and stricture formation at the gastroesophageal junction, resulting in incomplete obstruction, as evidenced by regurgitation and poor weight gain. Treatment by dilatation usually is successful. The author's patient required surgery at the age of seven days.

Esophageal Hiatus Hernia (3 cases): Delay in descent of the stomach may keep the esophageal hiatus abnormally dilated during development of the diaphragm, with resultant hernia contained in a sac. The esophagus is of normal length but buckled. The stomach is usually the herniated viscus. Symptoms rarely occur in infancy or childhood. Two of the 3 cases in this series were discovered incidentally on routine chest films.

Hernia Through the Foramen of Morgagni (1 case): Hernia through the foramen of Morgagni is due to failure of the central and lateral portions of the diaphragm to fuse, and there usually is a true sac. The single case of this type in the author's series presented symptoms requiring surgery.

Hernia through the Foramen of Bochdalek (23 cases): Embryologically the foramen of Bochdalek is the last segment of the posterior diaphragm to close, closure occurring at about the eighth or ninth week (a little later on the left). Delayed closure or early return of the midgut into the abdomen from the umbilicus may result

in plugging of the diaphragmatic opening posteriorly, with persistence of the foramen. There may or may not be a true sac. Symptoms of respiratory distress and cyanosis occur when the intestine fills with food and gas. The diagnosis is made by roentgen demonstration of gas-filled intestinal loops in the thorax, with collapse of the affected lung and shift of the mediastinum. Studies with an opaque medium are unnecessary as a rule and are indicated only in obscure cases to rule out lung cysts, staphylococcic pneumonia with abscess cavities, and duplication of the intestine. Treatment is surgical. Only 4 cases in the author's series had true sacs. Four deaths occurred.

Eventration of the Diaphragm (4 cases): Eventration of the diaphragm consists in a general stretching out of the diaphragm with a relative diminution of the muscular elements about the periphery. It may be due to migratory failure of the muscles between the layers of the pleura and peritoneum making up the diaphragm. Symptoms are absent or minimal. Diagnosis is by roentgenography and fluoroscopy. Pneumoperitoneum may help. Treatment is indicated in the presence of symptoms.

Congenital Absence of the Diaphragm: The author has no personal experience with this entity. [In the article preceding this one in the *Archives of Surgery*, "Congenital Absence of Hemidiaphragm and the Use of a Lobe of Liver in Its Surgical Correction," by William E. Neville and G. H. A. Clowes, Jr., 2 cases are described which were repaired as the title suggests. One patient died. The other did well. This type of repair was done experimentally on 16 healthy dogs, following the resection of one or both leaves of the diaphragm. Four died but the others showed excellent healing and no tendency to develop diaphragmatic hernia.]

The author's series of 33 cases included 15 patients less than six days of age. Six patients were over a year old.

Ten roentgenograms; 3 drawings; 1 table.

PAUL MASSIK, M.D.
Quincy, Mass.

Fate of Esophageal Hiatus Hernia: A Clinical and Experimental Study. Joseph L. Sprafka, Monouchehr Azad, and Ivan D. Baronofsky. Surgery **36**: 519–524, September 1954.

One hundred and forty-nine patients with small esophageal hiatus hernias (6 cm. or less in diameter) were followed by roentgen examination for periods up to eighteen years. Of 130 patients followed from one to five years, 17 (13 per cent) showed progression from small to large hernias. Of 19 patients followed for six or more years, 11 (58 per cent) showed a similar progression.

Of 61 patients with large esophageal hiatus hernias (involving one-third or more of stomach), 17 (28 per cent) showed roentgenologic evidence of serious complications, such as ulcer, esophagitis, or esophageal stricture, singly or in combination, in the herniated portion of the stomach.

In order to study the ulcer diathesis-abetting factor of esophageal hiatus hernia, hernias were produced surgically in dogs. Following operation, the dogs were allowed from three to four weeks to recover, after which those which were vigorous, eating normally, and maintaining weight were given intramuscular injections of histamine in beeswax (which has been shown to produce duodenal and gastric ulcers in laboratory animals). Histamine stimulation was continued until death of the dog, except for the sacrifice of a few animals which appeared terminally ill. Of 14 dogs with large hernias, 7 died of perforated ulcer in the hernia. The average time of death from perforation was 15.8 days after histamine administration was begun. Four dogs showed no evidence of ulcer in the herniated portion of the stomach. A perforated jejunum and a bleeding esophagus accounted for death in 2 animals. One dog died of an unknown cause. Perforation of an ulcer in the herniated portion of the stomach occurred in 1 of 14 dogs with small hiatus hernias.

The authors believe that esophageal hiatus hernia is a potentially serious disorder. Patients with small hernias should be kept under constant observation, consideration being given to their early repair should enlargement occur, before complications become manifest.

Two roentgenograms; 2 photographs; 2 tables.

Subcostosternal Diaphragmatic Hernia. Karl F. Hoffmann and Alexander J. Chilko. Ann. Int. Med. **41**: 616–629, September 1954.

Subcostosternal diaphragmatic hernia *i.e.*, hernia through the foramen of Morgagni, anteriorly, is usually found only by chance, at operation or at autopsy. The symptoms depend upon the organs involved in the hernia and the disturbance of function of these or neighboring organs through the hernial displacement. The lungs may be compressed, causing dyspnea, chronic cough, and hemoptysis. The heart action as well as the intrathoracic circulation may be impeded, producing pain substernally or in the shoulder region, palpitation, a feeling of suffocation, cyanosis, and weakness. When the colon, the small intestines, or the stomach participate in the hernia, their compression, torsion, or obstruction may cause chronic constipation, vomiting, meteorism, epigastric pain, intestinal hemorrhage, severe loss of weight, nausea, regurgitation, indigestion as in peptic ulcer, hematemesis, melena, abdominal colic, or difficulty in swallowing liquids rather than solids (paradoxical dysphagia). It is considered characteristic that the symptoms appear intermittently and are not related to meals, although the patients state that they cannot lie down after eating.

Roentgen examination in the Trendelenburg position alone will permit a diagnosis with reasonable certainty. The flat plate of the chest may show localized areas of rarefaction or increased density in the sternodiaphragmatic angle. Occasionally the haustrations of a loop of air-filled colon may be seen in the chest. Filling of the intestinal tract by a contrast medium will give further evidence of the presence of abdominal viscera in the thorax.

The differential diagnosis of eventration, pneumothorax, esophageal atresia, cardiospasm, perforation of the esophagus, and cancer of the stomach are discussed at length.

A case is reported, in a man of forty, in which the x-ray films revealed the transverse colon to be partly herniated into the thorax through an opening anterior to the heart, and situated between the latter and the anterior wall. A part of the herniated colon ran along the left border of the heart, taking on the shape of the latter and enlarging the cardiac shadow. The excursion of both hemidiaphragms was normal and synchronized. Further examination by barium enema showed that parts of the loops of the transverse colon located in the

hernial hiatus were moderately narrowed. A diagnosis of herniation of the transverse colon into the anterior mediastinum was made. The patient refused operation.

Among the complications which arise in cases of subcostosternal diaphragmatic hernia are hemorrhage, peptic ulcer, respiratory failure (in infants), emaciation and, most common, acute intestinal obstruction, chiefly through constriction of the colon by a narrow hernial ring.

Six roentgenograms; 1 table.

STEPHEN N. TAGER, M.D.
Evansville, Ind.

THE BONES AND JOINTS; THE SPINAL CANAL

Hyperparathyroidism Due to Parathyroid Adenoma. Report of Six Cases and a Review. I. McLean Baird, R. Grainger, and B. C. Rowlands. Brit. J. Surg. **42**: 140–151, September 1954.

Primary hyperparathyroidism is usually due to the presence of a parathyroid adenoma in the normal location or in an aberrant position, much more rarely to a primary hyperplasia of all parathyroid tissue. Diagnosis in a case with fully developed osteitis fibrosa cystica is relatively simple. Early diagnosis, however, is often difficult. Some of the confusing features are well demonstrated by the 6 case reports presented here.

The disease predominates in women, with a ratio of 3:1. Symptoms of lassitude, muscle weakness, and aching bone pain are often noted early. Polyuria associated with hypercalcuria and polydipsia is frequently a marked clinical feature. Bony swellings due to bone cyst, myeloid tumor, or to epulis or osteoclastoma may be an early finding. The presence of these lesions or bilateral renal calcification warrants a Sulkowitch test for calcium in the urine, and often full biochemical determinations, including serum calcium, inorganic phosphorus, alkaline phosphatase, and calcium balance.

Radiologically, generalized osteoporosis is often noted but is not a constant feature. Renal calculi and calcification and localized fibrocystic lesions of bone are familiar signs. Widespread visceral calcifications may be demonstrated in advanced cases. Occasionally the parathyroid tumor itself may be shown by soft-tissue radiography. The most important signs are the typical subperiosteal bone resorption frequently seen in the phalanges and said to be pathognomonic, and the mottled osteoporosis often demonstrated in the calvarium. Skull films and views of the hands are usually sufficient for radiological evaluation.

Primary hyperparathyroidism is to be differentiated from renal osteodystrophy, secondary hyperparathyroidism due to bony metastases, multiple myeloma, Paget's disease, and diabetes.

Two of the patients in this series were seen with a localized bone lesion the significance of which was not realized until a full osteodystrophy developed. Two of the group presented evidence of nephrolithiasis and two showed nephrocalcinosis. One patient, who later died of renal failure, had a coincident gastric carcinoma, but autopsy failed to show any distant metastases.

The operation and postoperative care are discussed and the problem of aberrant parathyroid adenomas is reviewed.

Six roentgenograms; four graphs.

JOHN F. RIESSER, M.D.
Springfield, Ohio

Bone Lesions in Kaposi's Sarcoma. Francesco Ronchese and Arthur B. Kern. Arch. Dermat. & Syph. **70**: 342–346, September 1954.

Numerous reports of Kaposi's sarcoma with bone changes are found in the foreign literature, but few cases have been described in America. The authors present a case.

A 33-year-old barber had noticed a lesion on the right foot at the age of fifteen years. The lesion was excised but subsequently recurred at the site of excision, and new nodules developed in the adjacent area. When first seen by one of the authors, at the age of seventeen, the patient had several bluish nodules on the medial aspect of the right foot. A diagnosis of Kaposi's sarcoma was made, and treatment with radium was given. Five years later a large, bluish, verrucous nodule had appeared on the medial aspect of the right heel and there were multiple bluish nodules over the right foot and ankle, and skin-colored nodules on the right thigh, abdomen, and scalp. The patient was completely asymptomatic. Roentgen examination showed cyst-like areas of rarefaction in the bones of the left hand and right foot. Although a bone specimen was not obtained for biopsy, it is believed that the osseous lesions were due to Kaposi's sarcoma. Two other conditions which might produce similar changes are gout and multiple myeloma, but there were no signs or symptoms suggestive of either of these diseases.

In the authors' opinion, it is most probable that new lesions of Kaposi's sarcoma do not develop as the result of metastasis, but are rather of autochthonous origin. The bone lesions in patients with Kaposi's sarcoma may represent new primary tumors.

Three roentgenograms; 2 photographs.

The Complications of "Osteitis Pubis." Including a Report of a Case of Sequestrum Formation Giving Rise to Persistent Purulent Urethritis. B. D. Stutter. Brit. J. Surg. **42**: 164–172, September 1954.

"Osteitis pubis" as visualized roentgenologically following retropubic surgery does not conform in appearance to the usual inflammatory processes of bone. The symmetrical decalcification of the pubes adjacent to the interpubic disk of fibrocartilage suggests that the terminology used is inaccurate. The author reviews the theories that have been advanced to explain the nature of the disease. He favors the explanation that the primary lesion is avascular necrosis of the interpubic fibrocartilaginous disk and that the apparent "osteitis pubis" is actually an osteoporosis of the adjacent bone due to increased vascularity and a complication of the disk necrosis. The terminology used by Breton, "osteoporosa dolorosa of the pubis," seems best to suit the condition from clinical, radiological, and operative points of view (Breton Plandiura: Arch. españ. urol. **7**: 227, 1951).

In the case reported here pain commenced in the perineum eight weeks after retropubic prostatectomy. The wound remained dry. Films showed an abnormally wide gap between the pubic bones and suggested "osteitis pubis." The painful condition appeared to resolve about eight months after operation, but at eleven months the patient was seen with a purulent urethritis and after further studies a spicule of bone was found at the junction of the bulbous and membranous urethra. This "sequestrum" was removed, and after a complicating left scrotal abscess was drained, the situation was apparently stabilized.

A review of numerous instances of osseo-urinary fistulas and passage or removal of sequestra is presented. The author suggests the possibility of heterotopic bone formation accounting for the presence of bone spicules or flakes in association with so-called "osteitis pubis." The epithelium of the urinary tract has unusual osteogenic properties. Bone will form where there is an excess of calcium and an abundant blood supply. The local decalcification of the pubes and possibility of the area being bathed in urine in addition to a satisfactory regional blood supply may support this hypothesis. Secondary infection, as well as providing a stepping stone toward the extrusion of sequestra and formation of urinary and osseo-urinary fistula, might well be responsible also for the occurrence of a true pyogenic osteomyelitis in addition to the "osteitis pubis."

Future therapy may be simplified and limited to excision of the dead interpubic disk.

Seven roentgenograms. JOHN F. RIESSER, M.D.
Springfield, Ohio

Postmenopausal Vertebral Osteoporosis. A. Nurra and P. Pasquali. Ann. radiol. diag. **27**: 171–196, May-June, 1954. (In Italian)

It is known that the rate of growth and maturation of the female skeleton is influenced by the estrogens. In cases of primary ovarian dysfunction (congenital atrophy) the growth of bone is altered so that the height of the adult is decreased. Furthermore, the bone age is retarded and closure of the epiphyseal plates is delayed. Senile osteoporosis also is believed to be due to hormonal deficiency. The authors studied 25 women (twenty-seven to sixty years of age) with vertebral osteoporosis following spontaneous or artificial menopause. All patients appeared older than the stated age and complained of lumbar pain which radiated to the abdomen and lower limbs. The spine was rigid, and dorsolumbar kyphosis was present. X-ray examination revealed osteoporosis of the lumbar spine and less frequently of the pelvic bones. The lesions were ill defined and haphazardly distributed. The cancellous portions of the iliac crests and the intervertebral disks were unaltered.

The full-blown syndrome was observed usually nine to ten years after the physiological menopause and four to five years after surgical removal of the gonads.

In radiological appearance and localization this type of osteoporosis is very similar to senile osteoporosis. Only the earlier age of these patients justifies (according to the authors) the separation of this disease entity from the postmenopausal osteoporosis observed in women over sixty-five.

In the differential diagnosis one must consider: (1) congenital lesions of the lumbar spine (Putti's *plastyspondylia*) which are evidenced by osteoporosis less severe and localized to one or two vertebrae, (2) metastatic neoplasms and plasmacytoma, (3) senile osteoporosis (see above), and (4) Paget's disease, which is more generalized and has characteristic biochemical findings.

The authors believe that the etiology of postmenopausal osteoporosis is a hypofunction of the osteoblasts in producing bone matrix. In some fashion, not yet clearly understood, estrogens stimulate the osteoblasts so that the ossification process can proceed normally (studies on the protein content of bone are in this respect highly pertinent). After a spontaneous or artificial menopause the hormonal stimulating process ceases, and the osteoblasts are unable to form and preserve the organic osseous framework.

From the above considerations it is easy to realize the relative inadequacy of any kind of therapy: estrogens, high protein diet, intravenous administration of calcium gluconate, and vitamin D have been tried, in some cases with temporary good results. Roentgen therapy is beneficial in the early acute phase if the pain is severe. The disease has a chronic course and the osteoporotic changes are irreversible regardless of the type of treatment.

Ten roentgenograms; 2 tables.

R. G. OLIVETTI, M.D.
Newington, Conn.

The Collagenous Changes in the Intervertebral Disk with Age and Their Effect on Its Elasticity. An X-Ray Crystallographic Study. A. Naylor, F. Happey, and T. Macrae. Brit. M. J. **2**: 570–573, Sept. 4, 1954.

The authors used x-ray crystallographic methods to study the changes that occur in human intervertebral disks in the aging process. The diffraction patterns obtained prove that the elasticity of the annulus fibrosus is dependent upon the orientation and mobility of the collagen fibrils, properties that decrease in degree with advancing age after the third decade. The nucleus pulposus shows increasing orientation and ultimate crystallization of the collagen with advancing years, indicating loss of gel structure and hence impaired elasticity. The combination of these factors will explain the reduced elasticity of the intervertebral disk with age.

Ten figures; 4 tables. JOHN J. CRAVEN, M.D.
Cleveland Clinic

Unusual Bone Regeneration in Pott's Disease. Harold H. Cohen. Am. J. Surg. **88**: 336–339, August 1954.

The author states that the usual signs of healing in Pott's disease, namely, bony ankylosis of the involved vertebral bodies and obliteration of the intervertebral space, are not always present. Recently cases of healed tuberculosis have been reported in which the disk was not entirely destroyed. In such cases regeneration of bone is the final criterion of arrest of the disease.

The case reported here is that of a three-year-old boy with a tuberculous focus in the body of L-2. In the course of three years, bony regeneration occurred in the diseased vertebra, but the intervertebral disk remained intact. The destroyed area of bone was finally replaced by new bone formation. There was no collapse of the vertebral body, although it was reduced in height. Spinal fusion was performed as part of the therapy. Streptomycin was given for a relatively short time and was not considered to play a major role in the healing.

Six roentgenograms. D. D. ROSENFELD, M.D.
Oakland, Calif.

Roentgenologic Visualization of the Extracapsular Fat: Its Importance in the Diagnosis of Traumatic Injuries to the Elbow. Hans-Gösta Norell. Acta radiol. **42**: 205–210, September 1954.

The author reviews the anatomy of the soft tissues about the elbow joint and shows that there are fat pads, extracapsular in position, in the coronoid and olecranon fossae. But while the fat pad in the coronoid fossa (the ventral fat pad) is normally visible on a lateral view, anatomical conditions are such that the dorsal

pad, in the olecranon fossa, cannot be visualized. The author failed to demonstrate it in any one of a series of 300 examinations of the normal elbow joint. With trauma to the elbow causing capsular distention, however, there is displacement of the fat pads so that both become visible roentgenographically.

In a series of 156 cases of elbow fractures, the dorsal fat pad could be visualized in 118. The lack of visualization in the remaining 38 cases is explained by the extracapsular nature of the fracture in some, the presence of casts in others, and improper radiologic technic in the remainder. The ventral fat pad was also shown to be displaced laterally in these cases.

The author believes that in cases of elbow trauma distention of the joint capsule by effusion, as evidenced by fat pad displacement, should alert one to the possibility of an intracapsular fracture.

Seven roentgenograms; 1 drawing.

ALBERT R. BENNETT, M.D.
Mt. Sinai Hospital, Cleveland

Roentgen Examination of the Proximal Femur End in Children and Adolescents. A Standardized Technique Also Suitable for Determination of the Collum-, Anteversion-, and Epiphyseal Angles. A Study of Slipped Epiphysis and Coxa Plana. Lars Billing. Acta radiol. Supplement 110, 1954.

From the diagnostic point of the view the examination of the capital femoral epiphysis in children and adolescents is of the greatest importance, since almost all significant lesions occur here. It is necessary that all views be obtained with the epiphyseal cartilage plane parallel to the axis of the x-ray beam, *i.e.*, vertical in position. The following views are described:

(A) Frontal view with the patient supine, the knee flexed 90° over the end of the x-ray table, and the axis of the lower leg tilted 20° away from the vertical plane.

(B) The ideal lateral view of the epiphysis with the patient supine, the femur elevated 25°, knee flexed 90°, and the lower leg sloping 25° back to the table top. This view produces 90° external rotation of the femur from view "A."

(C) The standard lateral view with the femur elevated 25°, the knee flexed 90°, and the lower leg supported on a box in the horizontal position. In this view the femur is externally rotated 107°, but the epiphyseal cartilage plane is still vertical.

(D) The ideal lateral view of the femoral neck: the femur elevated 50°, the knee flexed 90°, and the lower leg supported horizontally.

Three axes are important: (1) the diaphyseal axis, (2) the collum axis, and (3) the axis of the epiphyseal cartilage plane. On the frontal view (A), all of these axes are horizontal. Three angles are of significance: *v*, the anteversion angle; *u*, 180° minus the value of the angle between the diaphyseal and the collum axes; *s*, the angle formed by the diaphyseal and the epiphyseal axes.

The usual examination procedure is to obtain views A and C. On these two films the three axes are drawn, and the angle between the diaphyseal and the collum axes is measured. These angle values are plotted on the appropriate nomogram and the values of *u* and *v* obtained. When the value of *v* is more than 10 to 15 degrees, the lateral view B is made.

The epiphyseal angle is 87° rather than 90°. Since this angle is difficult to measure, it is easier in practice to measure the angle between the collum axis and the projection of the epiphyseal cartilage plane. When corrected in the manner described in the text, this becomes a satisfactory measure of the epiphyseal angle. The normal value is 88 to 90°. An angle of less than 78° is considered definitely pathological.

Study of 25 cases of slipped femoral epiphysis indicates that the epiphysis is displaced posteriorly. The amount of displacement is equal to the distance between the edge of the epiphysis and the point on the femoral neck where the edge of the epiphysis should be. This is measured on view B. In cases of epiphysiolysis, the angle between the femoral neck and the projection of the epiphyseal cartilage plane is less than 72°. In the symptom-free contralateral hip of these patients the angle has a value of 79°. Epiphysiolysis is, therefore, an abnormality with a pathologically small epiphyseal angle. In the absence of real slippage, this small angle may predispose to arthrosis in later life. A roentgen technic for nailing of a slipped epiphysis in situ is described. Both frontal and lateral views are obtained with a vertical x-ray beam.

Projections A, B, and C are suitable for the diagnosis of coxa plana. On any view where the epiphyseal cartilage plane is not vertical, the initial stages of the disease can be overlooked. Serial studies of such hips should be made with exact reduplication of position of the body part.

Forty-seven roentgenograms; 5 photographs; 2 drawings; 7 graphs and nomograms.

RICHARD F. MCCLURE, M.D.
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Traumatic Heberden's Nodes. Osteoarthritis of the Fingers Due to Injury. Robert M. Stecher and Harry Hauser. Am. J. Roentgenol. **72:** 452–461, September 1954.

Heberden's nodes are enlargements of the fingers due to osteoarthritis. Two forms have been identified: (1) those arising spontaneously on the fingers of middle-aged women as an hereditary trait, so-called idiopathic Heberden's nodes, and (2) those arising immediately after a painful injury, traumatic Heberden's nodes. Idiopathic Heberden's nodes have been accurately described. The present paper aims to set forth in some detail the characteristics of traumatic Heberden's nodes and to compare them to the idiopathic variety.

Traumatic Heberden's nodes occur most commonly in men. By far the largest number of affected persons have only one finger involved. An enlargement develops almost immediately after a painful injury and attains a resting stage in several months. This is in striking contrast to idiopathic nodes, which begin gradually in one finger, developing slowly over a period of months to several years and spreading from one finger to another without history of injury.

Traumatic Heberden's nodes do not show as much deviation from a straight line as do Heberden's nodes of idiopathic origin. Enlargement across the dorsum of the joint is characteristic. The roentgen changes are best seen in a lateral view. The characteristics noted in traumatic nodes are a clear and regular joint space, smooth and parallel joint surfaces, absence of deformity at the distal end of the middle phalanx, and enlargement of the proximal end of the distal phalanx. In lateral views of idiopathic nodes, on the contrary, the joint spaces are reduced and poorly defined and the bony enlargements have the appearance of pointed spurs arising from both the dorsal and ventral surfaces of the

proximal end of the distal phalanx and from both surfaces of the distal end of the middle phalanges.

Eleven cases are reported.

Thirteen roentgenograms accompanied by photographs of the phalanges. JOSEPH P. TOMSULA, M.D.
Baton Rouge, La.

Opaque Arthrography of the Knee. A Study of a Series of 100 Examinations. Claude Lagarde, with assistance of J. Gandin and J. Illes. J. de radiol. et d'électrol. **35:** 714–726, 1954. (In French)

This is a study of 100 arthrograms of the knee obtained with the water-soluble contrast agent Diodone. About 10 to 12 c.c. of 35 per cent Diodone is injected after evacuation of any liquid obtainable. The site of puncture is 1 cm. lateral to the mid-point of the external patellar margin, the point of the needle being directed along the posterior patellar wall. Radiographs are taken in five positions: anteroposterior, straight and with 45° of internal and external rotation, posteroanterior, and lateral. Two films are exposed in each position, with the angulation of the tube changed 6° between exposures. This permits a stereoscopic effect and eliminates misleading shadows.

It is necessary to recognize the normal appearance of the opaque arthrogram. The internal meniscus is adherent to the capsule throughout. The adherence of the external meniscus is interrupted in its mid-posterior segment, which permits the Diodone to enter the meniscal triangle. A small recess is seen at the femoral and tibial margins. In 20 per cent of patients the synovial cavity communicates with the bursa semimembranosa. The cruciate ligament is best seen in the lateral view, the anterior portion forming a 45° angle, and the posterior portion a 60° angle, with the tibial plateau.

Fissures in the menisci are well outlined, but detached fragments are poorly visualized. Rupture of the capsule and injuries of the cruciate ligament may be seen.

Of 100 arthrographic studies, 38 were considered normal. Sixty meniscal lesions were demonstrated, 53 of the internal meniscus, 1 mixed internal and external, and 6 of the external meniscus. In 2 cases the lesion of the internal meniscus was associated with a capsular rupture, and in 2 others with a disinsertion of the cruciate ligament. There was 1 case of isolated capsular rupture and 1 of hypertrophic synovitis.

Thirty-eight patients underwent surgery. In 3 with normal radiologic studies, the operation was considered to be indicated by clinical signs. In 2 of these the menisci were normal. In the third, a detachment of the posterior two-thirds of a meniscus was found. This was the only case in which there was total disagreement between the arthrogram and the surgical findings. None of the 35 menisci judged diseased on arthrography were found to be normal at surgery. In 28 cases there was complete agreement between the radiologic and surgical findings, and in 7 there was partial disagreement, due to misinterpretation of the extent of the lesions.

Forty roentgenograms; 13 photographs.
CHARLES M. NICE, JR., M.D.
University of Minnesota

Roentgen Manifestations of Epidural Granulomas of the Spine, with a Report of Ten Cases. John A. Campbell and Richard A. Silver. Am. J. Roentgenol. **72:** 229–246, August 1954.

Among the disease processes which involve the contents of the spinal canal are a group of acute and chronic inflammatory tumors arising in the extradural space and manifesting themselves as localized mass lesions. These are the so-called "epidural granulomas." The majority of these lesions develop in the mid-dorsal spine in the younger age groups. They occur as a complication of vertebral osteomyelitis or by direct extension from an infection adjacent to the vertebral column.

Since the epidural granulomas can produce irreparable or serious cord damage, frequently leading to fatal outcome, their detection by roentgenologic means is of importance. In general, there is no pathognomonic roentgen appearance which will invariably distinguish these lesions from extradural neoplasms. The useful procedures in the roentgen diagnosis are plain films of the spine, laminagraphy of a spinal segment, and myelography.

Plain films are often completely negative, although they may yield one or more of the findings indicative of vertebral osteomyelitis, intraspinal pressure, and perivertebral inflammation. The vertebral body may show demineralization, loss of marginal definition, beveling of the vertebral edges, absence of a bony plate, destructive changes, collapse, infraction, and an asclerotic zone adjacent to the disk. The neural arch may also show demineralization and loss of definition, with loss of the white line around the pedicles (especially medially), destructive changes in the pedicles, lamina, and spinous process, and widening of the spinal canal and intervertebral foramen. Extravertebral findings on the plain film are scoliosis, kyphosis, paraspinal soft-tissue density, destruction of the vertebral end of a rib, and intervertebral disk narrowing.

More decisive to diagnosis are the myelographic findings. The authors state that completely negative myelography practically excludes an epidural granuloma. The pertinent changes are as follows: (1) a smooth extrinsic indentation of the lateral margins of the oil column; (2) thinning and tapering of caliber of the oil column above or below the lesion; (3) marked ductility of the head of the column proximal to the obstructing lesion; (4) abrupt extradural obstruction, often at a level some distance from the neurological level; (5) incomplete extradural obstruction with irregular splitting of the oil column.

The authors describe the clinical and roentgen aspects of 10 cases of epidural granuloma. Early recognition will permit neurosurgical intervention before irreparable cord damage develops.

Twenty-four roentgenograms; 1 anatomical drawing.
DANIEL WILNER, M.D.
Atlantic City, N. J.

Myelography to Help Localize Traction Lesions of the Brachial Plexus. I. M. Tarlov and Robert Day. Am. J. Surg. **88:** 266–271, August 1954.

The authors report 3 cases of traction injury to the brachial plexus and point out the value of cervical myelography in determining the site of injury. Theoretically this may be intraspinal or extraspinal, and the surgical approach in the two types would differ.

Intraspinal avulsion of the nerve roots produces irregularities in the opaque Pantopaque column. There may be asymmetry of the axillary pouches, those on the side of injury being cut off, or there may be arachnoid diverticula or accumulations of Pantopaque lateral to the usual borders of the subarachnoid space. Extraspinal lesions cause no myelographic defects.

In the 3 reported cases, intraspinal avulsion of the nerve roots occurred. Although laminectomy was performed to determine the extent of injury, repair of the nerves was not possible.

Experiments performed on infant cadavers by the authors indicate that sustained traction laterally and caudally usually causes avulsion rather than severance of the roots. The roots of C-5 and C-6 were most commonly affected.

Four roentgenograms; 1 drawing.

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GYNECOLOGY AND OBSTETRICS

Diagnostic Transabdominal Pneumoperitoneum in Children. Ralph H. Kunstadter and Alex Tulsky. Am. J. Obst. & Gynec. **68:** 819–829, September 1954.

The authors stress the value of transabdominal pneumoperitoneum in young female children for the determination of pelvic anomalies. Bimanual examination is unsatisfactory in this age group and clinical and laboratory findings may be inconclusive. In such cases pneumoperitoneum may permit a diagnosis and avoid the necessity of exploration.

The method of pneumoperitoneum originally devised by Stein (see Radiology **7:** 326, 1926) has been adapted for use in these young patients: 300 to 700 c.c. (average 500 c.c.) of carbon dioxide is introduced under 10 to 20 mm. Hg pressure through a transabdominal puncture, except in small infants, in whom oxygen (100 c.c.) is used. The radiographic examination is done with the child in a modified knee-chest position with the Potter-Bucky diaphragm close to the abdominal wall. The factors are 65 to 70 kv, 100 ma, 1/10 second. Prior to the induction of pneumoperitoneum, other diagnostic procedures are undertaken as indicated, such as urinary 17-ketosteroid determinations, examination of vaginal smears for estrogen activity, x-ray studies of the sella turcica, bone age determinations, and endometrial biopsy.

Twenty-one patients with various sex-endocrine disturbances were examined successfully by the technic described. The conditions represented were ovarian agenesis, hypopituitarism, hypo-ovarianism, cystic ovary, constitutional sexual precocity, pseudohermaphroditism, and polycystic ovaries. Seven cases are presented, with illustrations and brief clinical summaries.

Six roentgenograms; 7 photographs; 1 table.

OLIVER R. ROTH, M.D.
Jefferson Hospital, Philadelphia

Uterus Duplex Unicollis. Benedict B. Benigno. Am. J. Obst. & Gynec. **68:** 860–866, September 1954.

The author reviews the literature on uterus duplex unicollis and adds 5 cases from a series of 23 from New York University Hospital.

Symptoms are usually absent. The most common complaints are related to the menses, dysmenorrhea being of common occurrence. Fertility and frequency of conception are not adversely affected, but abortion occurs in some 50 per cent of cases. Pregnancy in both horns has occurred; if both reach term, there is a definite increase in the complications of labor.

The diagnosis is complex and is seldom made on physical examination alone. Uterosalpingography is the most certain diagnostic aid prior to exploration. Uterine myomas are found frequently in association with this anomaly.

Therapy must be adapted to the individual case. Conservative measures are favored.

Four roentgenograms. OLIVER R. ROTH, M.D.
Jefferson Hospital, Philadelphia

Opacification of a Calcified Leiomyoma during Hysterosalpingography. Meyer Alpert and B. Douglas Lecher. J. Canad. A. Radiologists **5:** 38–41, September 1954.

A thirty-three-year-old white female was admitted to the hospital for treatment of menometrorrhagia. Bimanual examination revealed enlargement of the uterus to the size of an eight-week gestation, and firm nodules could be palpated on the uterine surface. A preliminary plain film revealed the presence of two calcifications in the pelvis. One was projected over the third sacral foramen on the right side and had a stippled configuration due to tiny calcific deposits extending over an area 1 cm. in diameter. The other, a little lower down, appeared to be composed of closely grouped concretions. When hysterography was undertaken, the uterine cavity was found to be enlarged, requiring 12 c.c. for complete filling. When the final amount of Lipiodol was introduced, the previously described calcification on the right side of the uterus became opacified. The twenty-four hour film showed a few droplets of oil still remaining in this region.

At laparotomy a uterus the size of a ten- to twelve-weeks gestation was removed. Its surface was studded with small subserous fibroids both anteriorly and posteriorly. The uterine specimen was studied by means of plain roentgenograms and the stippled calcification was visible in a knob-like protrusion from the fundus. A denser calcification was projected within the uterine substance. Lipiodol was then injected into the uterine cavity and the intramural fibroid was again outlined by means of a sinus tract leading from the endometrial cavity.

Four roentgenograms. ALFRED O. MILLER, MD.
Louisville, Ky.

Tubal Ligation (Sterilization) by a Modified Madlener Method. W. J. Dieckmann and J. P. Harrod, Jr. Am. J. Obst. & Gynec. **68:** 897–902, September 1954.

Of an earlier series of 912 women in whom tubal ligation was done by a modified Madlener method, 3.6 per cent subsequently became pregnant (Dieckmann and Hauser: Am. J. Obst. & Gynec. **55:** 308, 1948). The method has been called unsound and other procedures have been suggested, but in all a certain percentage of failures has occurred. The authors have therefore continued with the Madlener technic as originally described, using, however, the broader base portion of the Payr clamp to crush the tube. In 565 cases their failure rate was 3.2 per cent.

More recently sodium morrhuate has been injected into the tubes following ligation by the Madlener method. In 130 cases thus treated and followed for two years or longer, there have been no failures. By placing a tantalum wire marker at the site of ligation and subsequent injection of Lipiodol, it has been possible to evaluate tubal patency roentgenologically.

Eight roentgenograms; 3 tables.

OLIVER R. ROTH, M.D.
Jefferson Hospital, Philadelphia

THE GENITOURINARY SYSTEM

The Anatomy of the Intrarenal Arteries and Its Application to Segmental Resection of the Kidney. F. T. Graves. Brit. J. Surg. **42**: 132–139, September 1954.

Knowledge of the vascular pattern of the kidney is essential in order that the surgeon may perform the partial nephrectomy now advocated by many in the treatment of renal tuberculosis and calculus. Control of hemorrhage is one of the technical difficulties of this operation, as well as the more common procedure of nephrolithotomy. The author presents the results of a work aimed at clarification and documentation of the anatomy of the intrarenal arteries in man, in the hope that the findings may result in a more satisfactory approach to these surgical procedures.

Postmortem specimens of the kidney were injected by way of the renal artery after *en bloc* dissection of the organ and the surrounding tissues. The plastic used for injection gave a good outline of the arterial pattern after removal of the kidney substance by corrosion in hydrochloric acid. Casts were thus made of the renal vessels in about 30 specimens. An additional group of specimens were studied by perfusion and angiography with 50 per cent and 70 per cent solutions of Diodone.

On the basis of arterial distribution the kidney is divisible into five segments: (1) the *apical segment*, which occupies the medial side of the upper pole, mainly on its anterior surface; (2) the *upper (anterior) segment*, covering an area including the upper pole and part of the central area anteriorly; (3) the *middle (anterior) segment*, which includes the lower central part between the upper and lower segments in the anterior plane of the kidney; (4) the *lower segment*, which forms the lower pole in both anterior and posterior planes; (5) the *posterior segment*, which lies entirely in the posterior plane and occupies the area between the posterior part of the apical segment above and the posterior portion of the lower segment below.

There is no collateral circulation between the arterial segments, although there is a free venous anastomosis. Ligation of a segmental artery will not produce ischemia of neighboring segments. Lack of arterial anastomosis renders resection easier, since the field of operation is relatively bloodless following ligation of the segmental artery.

Minor variations of origin and distribution of the various segmental arteries and accessory vessels are catalogued in the text of the paper. Preoperative arteriograms and even renal arteriograms or segmental arteriograms obtained at the time of operation may be of value in identification of variations and accessory vessels.

Four angiograms; 7 photographs; 9 diagrams.

JOHN F. RIESSER, M.D.
Springfield, Ohio

An Angiographic Study of the Renal Circulation in Experimental Hypertension in the Dog. P. M. Daniel, Marjorie M. L. Prichard, and J. N. Ward-McQuaid. Brit. J. Surg. **42**: 212–216, September 1954.

The object of this study was to determine whether there is any change in renal circulation in the dog with experimental hypertension. It has been suggested that in this condition the blood-flow through the renal cortex might be diminished, while that through the medulla is maintained or even increased. This work represents a small parallel investigation conducted in association with a larger angiographic study on rabbits by these same authors (Brit. J. Surg. **42**: 81, July 1954. Abst. in Radiology **64**: 767, 1955).

Young adult dogs were first subjected to a right nephrectomy. The left kidney was exteriorized in order to obtain renal angiograms of good definition. A Goldblatt clamp was applied either to the left renal artery itself or to one of its two primary branches. Hypertension was produced in varying degree in nearly all of the 17 dogs which made a recovery from application of the clamp.

Rapid serial angiograms of the renal circulation were made in the exteriorized left kidney of 12 dogs, from eight to forty-two days after application of the clamp. When the clamp had been applied to one branch of the renal artery only, the circulation through the kidney supplied by that branch was greatly diminished. The circulation through the remainder was unimpaired. Where the clamp had been applied to the main renal artery, there was apparently no abnormality of the circulation in the kidney. An exception to these findings was observed in a few animals in which uremia developed. In these, the renal circulation, in both cortex and medulla, was impaired.

There was a consistent reduction in mean blood pressure and pulse wave across the renal clamp.

Eighteen roentgenograms; 1 tracing.

JOHN F. RIESSER, M.D.
Springfield, Ohio

Retrograde Pyelography with Hydrogen Peroxide in the Contrast Medium. Preliminary Report. Paavo Klami. Acta radiol. **42**: 181–188, September 1954.

The author previously advocated the addition of hydrogen peroxide to the contrast medium for visualization of ulcerative processes in the esophagus (Acta radiol. **39**: 98, 1953. Abst. in Radiology **61**: 975, 1953). Here he reports the application of this principle to 4 cases of ulcerative kidney lesions. In each instance conventional retrograde pyelography failed to reveal the lesion, although an ulcerative process was suspected from the clinical and laboratory data.

The hydrogen peroxide in the contrast medium, when it comes in contact with the ulcerative process in the calyces, is decomposed by the pus cells, with the formation of foam, so that the medium is "lifted" away or separated from the lesion. This is demonstrated radiographically.

The pyelographic medium used was water-soluble Uriodone Forte, to which saline and hydrogen peroxide were added to make a solution containing Uriodone 35 per cent and hydrogen peroxide 3 or 1.5 per cent.

Eight roentgenograms.

ALBERT R. BENNETT, M.D.
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The Ectopic Ureter: Diagnostic Problems. D. Innes Williams. Brit. J. Urol. **26**: 253–260, September 1954.

Many cases of urinary incontinence due to an ectopic ureter have been reported, but the difficulties which arise in diagnosis, particularly when the ectopic orifice cannot be found and the corresponding renal element is unable to concentrate Diodone, are not always stressed. The object of the present communication is to draw attention to these diagnostic problems. The material consists of 11 cases, including 4 previously recorded.

Difficulties in diagnosis arise from two factors. In the first place, atypical symptoms may lead to a faulty selection of cases for investigation; in the second, the investigations themselves may leave some doubt as to the presence and the site of the ectopic ureter.

The typical complaint in a girl with an ectopic ureter is a continual dribbling incontinence, worse by day than by night, despite normal acts of micturition performed at normal intervals. Provided this history is accurately given, the diagnosis may be presumed on this basis alone. A boy with a urethral ectopic ureter, or a urethral diverticulum, may also complain of continual dribbling, but more often in boys such a history is misleading and no abnormality is found.

Clinical examination of a child with an ectopic ureter is on the whole disappointing; occasionally the ureteric orifice may be seen behind and lateral to the external meatus, and urine may be observed flowing from it. More often only the presence of urine in the vagina gives a clue as to the nature of the disorder, the orifice being hidden in the depths. A ureteric orifice in the urethra may be seen on urethroscopy, and although endoscopy is also possible in the vagina, an orifice in this situation is hard to identify. Nor is the intravenous injection of indigo carmine likely to be of assistance.

Direct evidence of the presence of an ectopic ureter can be obtained only by localizing the extravesical orifice, catheterizing it, and performing retrograde ureterography, but since the orifice is so often difficult or impossible to locate, it is frequently necessary to rely upon the indirect evidence afforded by pyelography and cystoscopy. An ectopic ureter must be either the only ureter draining one of the kidneys or else, and more commonly, one of the pair from a double pelvis. In the first instance, there will be only one, the contralateral, ureteric orifice in the bladder and, provided that the kidney in question is capable of secreting contrast medium in sufficient concentration to cast a shadow in the intravenous pyelogram, no difficulty in diagnosis will arise. Such kidneys are, however, frequently abnormal in position, size, or secretory capacity, and it is therefore not unlikely that the intravenous pyelogram will disclose no evidence of a kidney on the affected side, a finding which, together with absence of a ureteric orifice in the bladder, may suggest an agenesis of the kidney and ureter. In girls with a characteristic history of incontinence, with two normal ureteric orifices, the intravenous pyelograms must be carefully scrutinized for evidence of a double kidney. The difficulty then arises that, since the renal element from which the ectopic ureter is derived is almost always hypoplastic, the pyelograms may not show an obvious double kidney or the "obvious" duplication may, in fact, represent a bifid ureter to the kidney contralateral to that bearing the ectopic ureter.

It is important to recognize the pyelogram which represents only the lower pelvis of the double kidney. Some writers seem to rely upon the general impression and liken the appearance to that of a "drooping flower"; others depend upon more easily analyzable facts, such as a deficiency in the number of calyces and the stunted outline of the upper calyx. In order to put these criteria to test, the outlines of a series of lower pelves of double kidneys were traced, and the tracings are reproduced. In the first set of 10, the ureter from the upper pelvis ended extravesically; in 5 of these the pyelograms showed faint signs of secretion in the upper renal element, and in 5 no shadow of this pelvis appeared at all. In the next set of 5, the ureter from the upper pelvis ended in the upper urethra, but the dilated segment immediately above this orifice formed a bulge on the trigone of the bladder closely resembling a ureterocele. In these, therefore, the ureter was ectopic but was placed too high to cause the typical incontinence. In the last set of 10, representative of a much larger number, the ureters either joined one another above the bladder, or opened close together at the corner of the trigone. A review of the tracings suggests that there is no single criterion of diagnosis, but the following features should be considered:

1. The number of calyces. A deficiency in number can be judged only in relation to the opposite normal kidney; it may be obvious, but it is seldom helpful in doubtful cases.

2. Outward displacement of the upper pole. In many cases the uppermost calyx of the lower pelvis appears to be pushed downward and laterally, giving in extreme cases the "drooping flower" outline. In these the abnormality can scarcely be overlooked, though it must be borne in mind that a very similar appearance may be seen in adrenal neuroblastoma, and even in tumors of the upper pole of the kidney.

3. Shortening of the upper calyx. In some cases this calyx is directed vertically upward, and has even a "cup" directed medially, as in many normal kidneys, but the infundibulum is much shorter than in the middle and lower calyces.

4. Displacement of the pelvis and upper ureter away from the vertebral column. This feature again is best judged by comparison with the opposite kidney: the ureter from the lower pelvis, instead of running in medially toward the vertebral column and then turning downward close to or superimposed upon the transverse processes, heads directly downward from the renal pelvis and only gradually approaches the vertebrae.

Two roentgenograms; 25 tracings.

Ureterograms. G. C. Tresidder. Brit. J. Urol. **26:** 240–248, September 1954.

Two cases of secondary carcinoma of the ureter are presented to show the superiority of ureterography over pyelography in the diagnosis of some upper urinary tract lesions. The author believes that in certain conditions more information can be obtained from a ureterogram than from a pyelogram, that the pelvis of the ureter can be filled without passing a catheter right up to the pelvis, thereby lessening the likelihood of causing an infection of the urinary tract, and that the whole length of the ureter itself can be clearly demonstrated.

The technic for ureteropyelography is as follows: The patient lies on the x-ray table with his legs either held up or placed on supports. With a Brown-Buerger cystoscope, a Braasch bulb catheter is engaged in the ureteric orifice on the suspected side. The bulb is passed up against the orifice, and 4 to 6 ml. of Pyelectan (retrograde), to which 1 ml. of 0.4 per cent indigo carmine has been added, are injected, and a film is exposed. The appearance of blue dye from the orifice indicates that the medium is leaking back, and the bulb must be more firmly engaged. This procedure gives satisfactory filling of the ureter. With injection of a further 3 to 5 ml. of Pyelectan an adequate pyelogram may be obtained.

Occasionally Viskiosol Six is used as the contrast medium. Since this is a viscous solution, it remains in

the tubular part of the ureter after injection; it has little tendency to pass up to the pelvis.

Following the demonstration of a non-functioning kidney by excretion pyelography, the next logical point is to establish the level of the obstruction and then its nature. In unilateral renal obstruction the level may be anywhere above the ureteric orifice in the bladder. Cystoscopy will reveal the state of the orifice and the surrounding area. Ureteral obstruction, partial or complete, can be shown by a ureterogram—it cannot always be determined by passing a catheter up to the kidney. In one of the author's cases the obstruction was extra-ureteric and in the other intra-ureteric, and yet in neither was any resistance felt to the passage of a catheter. Ureterograms are an aid not only in establishing the level and length of obstruction but also indicate whether the obstruction is intra- or extra-ureteral. With ordinary retrograde pyelography, it is possible to infect the pool of residual urine; with urerography there is less chance of introducing infection. For these reasons, the routine use of ureterography in renal and ureteral obstruction is recommended.

Five roentgenograms; 5 drawings; 3 photographs.

THE ADRENALS

Pheochromocytoma. A Case Report. S. J. Forrest and L. Goldberg. J. Canad. A. Radiologists **5:** 36–37, September 1954.

A white female, aged 33, entered the hospital complaining of almost constant headache and nausea and vomiting which came in cyclic bouts. These symptoms had been present over five years, but had become acute in the last four months. Blood pressure readings on admission showed a wide fluctuation, from 240 to 140 systolic in the course of a minute or so. This finding was verified repeatedly and the tentative diagnosis of pheochromocytoma was made. A benzodioxane test was considered to be positive.

Plain films of the abdomen and intravenous pyelograms showed no abnormality. Retroperitoneal insufflation was performed by injection of air into the presacral retroperitoneal space with a spinal puncture needle, and a mass was demonstrated in relation to the upper pole of the left kidney. In the lateral view this could be seen to cap the kidney. At operation a large tumor measuring 9 × 7 × 4 cm. was removed from the region of the left adrenal gland. The pathological diagnosis was pheochromocytoma. The immediate postoperative course was uneventful.

Two roentgenograms; 1 photomicrograph.

ALFRED O. MILLER, M.D.
Louisville, Ky.

MISCELLANEOUS

The Value of a Routine Abdominal Film. Morris H. Levine and Stanley Crosbie. J.A.M.A. **156:** 220–222, Sept. 18, 1954.

The authors advocate the use of a routine scout film of the abdomen as an admission procedure, similar to the now widely accepted admission chest survey. The kidney, ureter, and bladder roentgenogram obtained with the patient supine appears to be the most useful, since it gives information as to a variety of systems. The authors have found that it nearly always permits them to judge whether the liver, spleen, or kidneys are enlarged or abnormal in shape or position. The psoas muscles are nearly always identified. Calcifications in the abdomen and bony pelvic canal are readily demonstrated. Much information is presented regarding the lumbar spine and pelvis with regard to alignment of vertebrae, old and recent fractures, inflammatory and neoplastic bone disease, and calcium content of the skeleton in nutritional and endocrine disease.

Routine films of this type were obtained in 242 patients consecutively admitted to a Veterans Administration Hospital in the fall of 1952. In spite of no special preparation of the patient, 76 per cent of the films showed good or excellent detail and 98 per cent were acceptable. The films were of value as follows: as a negative study in 37 per cent of the cases; as part of a subsequent examination in 47 per cent; confirming or reinforcing the clinical diagnosis in 24 per cent; disclosing information that might not otherwise have been obtained in 11 per cent. This last figure compares favorably with figures given for the value of routine chest surveys.

JOHN P. FOTOPOULOS, M.D.
University of Michigan

Lead EDTA Complex: A Water-Soluble Contrast Medium. N. Sapeika. South African M. J. **28:** 759–762, Sept. 4, 1954.

Lead EDTA Complex: Further Radiographic Studies. N. Sapeika. South African M. J. **28:** 953–956, Nov. 6, 1954.

Lead Calcium EDTA. N. Sapeika. South African M. J. **29:** 108–110, Jan. 29, 1955.

Ethylenediamine tetraacetic acid (EDTA) is an amino acid that acts as a chelating agent. *i.e.*, it combines so tightly with a metal—in this instance lead—that the latter is "unionized" and thus unable to participate in its usual reactions. The author has taken advantage of this property to produce a contrast medium, which he has used in experimental animals, hoping that it may eventually find a place in clinical radiology.

Lead was early shown to be a radiopaque medium but the use of ordinary lead compounds as contrast media has long been discontinued because of their toxicity. The availability of the EDTA complex, which is water-soluble and apparently non-toxic, suggested its use to the author for contrast purposes. Animal tests on rats and rabbits confirmed the absence of toxicity, and experiments were accordingly undertaken to demonstrate the usefulness of the complex in radiography.

In experimental animals gastrointestinal visualization following oral administration was found to be more homogeneous than with barium, since the complex is freely miscible with intestinal fluids. Subcutaneous injections were absorbed within one hour. The renal pelves, ureters, and urethra were clearly visible after subcutaneous or intravenous injections. Angiography and microradiography were also satisfactory. Some transient fall in blood pressure was noted after large intravenous doses.

Lead calcium EDTA in 15 per cent solution produced satisfactory shadows of the gastrointestinal tract when given orally to rats, but denser shadows were obtained with the lead sodium EDTA complex used in the earlier studies, since this could be used in much more concentrated solutions. The calcium complex proved unsuitable for intravenous pyelography because of its low solubility, which prohibited adequate concentration.

Sixteen roentgenograms (in the first two of the three papers).

RICHARD E. BUENGER, M.D.
Chicago, Ill.

Gas Insufflation through the Lumbar and Presacral Routes. Seymour F. Wilhelm. Surg., Gynec. & Obst. **99**: 319–323, September 1954.

The author describes the lumbar and presacral methods of perirenal insufflation and states his preference for the lumbar route. Using a slow, low-pressure technic, with a two-bottle pneumothorax apparatus, he had no fatalities or serious complications in 150 cases. He cites 2 cases, however, in which more rapid hand-syringe injection resulted in gas embolism: one patient, injected with 800 c.c. of air by the presacral route, died; the other, injected with 250 c.c. of air directly into the loin, recovered.

The author stresses strict aseptic technic, use of a blunt cannula with a sharp obturator, and very slow injection of the gas (preferably between thirty minutes and an hour). The chance of having gas accumulate in the right ventricle is less when the patient lies on the left side. The type of gas does not appear to make any great difference.

In spite of difficulties and possible complications, the advantages derived from this type of diagnostic procedure in many cases is believed to justify its continued use.

Four roentgenograms. C. E. DUISENBERG, M.D.
Palo Alto, Calif.

RADIOTHERAPY

Experiences at Zürich with Radiotherapy of Laryngeal and Hypopharyngeal Carcinoma, with Reference to the New International Staging Classification. K. Schärer. Schweiz. med. Wchnschr. **84**: 1059–1063, Sept. 11, 1954. (In German)

The results of radiation treatment of carcinoma of the larynx and hypopharynx in 609 patients seen in the radiotherapeutic clinic of the Zürich Kanton Hospital between 1929 and 1950 are reported.

A tabulation of the results according to the classification established by Schinz and Zuppinger and in use for several decades is given first. Then the same cases are grouped according to the new international classification proposed by the "International Committee on Stage-Grouping in Cancer and for the Presentation of the Results of Treatment of Cancer" (ICPR), organized by the International Congress of Radiology. The following stages are recognized.

Stage I: Carcinoma limited to the mucosa; larynx normally movable; no palpable lymph nodes.

Stage II: Carcinoma infiltrating but with no extralaryngeal extension; mobility of the larynx restricted or abolished; no palpable nodes.

Stage III: Extension of the carcinoma beyond the larynx or palpable but movable lymph nodes.

Stage IV: Extension of carcinoma through the skin, or fixed lymph nodes or distant metastasis.

Nine tables are presented which permit a detailed statistical analysis of the material by both methods. The last one summarizing the results according to the ICPR classification reads as follows:

Three-year cures	Five-year cures	Ten-year cures
Stage I 78%	Stage I 50%	Stage I 17%
II 52%	II 43%	II 28%
III 23%	III 16%	III 8%
IV 6%	IV 3%	IV 2%

The principal conclusions of the author are:

(1) For Stage I, radiotherapy is the treatment of choice.

(2) Lymph node metastases are more radioresistant than the primary tumor.

(3) Previous reports containing the Schinz classification can be converted into the ICPR classification without requiring a new survey of the material.

(4) The international classification, though less detailed and less adaptable to individual cases, has the advantage of containing classes with a larger number of cases in each division.

Eight tables. GERHART S. SCHWARZ, M.D.
New York, N. Y.

Cancer of the Cervix. A. N. Arneson. Minnesota Med. **37**: 636–640, September 1954.

The author discusses the factors he considers important in estimating prognosis in carcinoma of the cervix. Data are utilized from two parallel series of cervical cancer studied during the years 1935–47. One series, consisting of private patients, numbered 452 cases and produced 40.5 per cent five-year cures. The other series was made up of 990 ward patients and produced 25 per cent five-year cures. The series are called "parallel" in that the cases studied were treated by the same group of physicians over the same period of years and utilizing the same therapy methods. The groups are further analyzed with respect to the numbers of cases falling into each stage of the League of Nations classification. Those factors the author attempts to correlate relative to prognosis are: (1) architecture of the tumor; (2) presence and degree of infection; (3) nutritional and hygienic factors; and (4) spread of the tumor at the time of institution of treatment. Tumor spread is by far the most important single factor.

It is concluded that the better overall results in private patients are best explained on the basis of more favorable cases from the point of view of less tumor spread, better nutrition, and less severe degrees of infection. The poor prognosis to be expected in patients showing lymph node spread is re-emphasized. It is suggested that radioactive gold may assume a more important position in this respect.

Four tables; 1 graph. J. W. BARBER, M.D.
Cheyenne, Wyo.

The Dosage Distribution in the Pelvis in Radium Treatment of Carcinoma of the Cervix. Rune Walstam. Acta radiol. **42**: 237–249, September 1954.

The author presents a series of schematic anatomical drawings of the female pelvis, upon which have been plotted isodose curves for various arrangements of intravaginal and intrauterine radium sources. He used a water phantom with a scintillation type dosage rate meter to compute gamma roentgen doses at various points about the radium applicators. The sketches are approximately one-third life size, so that it is somewhat difficult to obtain from them precise isodose readings.

The series of curves have been worked out for the more common groupings of applicators used in the so-called Stockholm method of radium application and the charts are applicable only to that technic. The author states that the main value of the isodose charts is that they allow a more individualized arrangement of applicators for the particular pelvic tumor to be treated.

A more complete series of charts for other radium distributions is to be published at a later date.

Thirteen anatomic sketches; 2 diagrams; 1 photograph. J. W. BARBER, M.D.
Cheyenne, Wyo.

Transvaginal Roentgen Therapy in Cancer of the Cervical Stump. Ralph M. Caulk. Am. J. Roentgenol. **72:** 469–472, September 1954.

Of 812 cases of carcinoma of the cervix treated at Garfield Memorial Hospital (Washington, D. C.) during the years 1932–52, 55 (6.7 per cent) are considered examples of true cervical stump cancer. By definition, cancer appearing over two years after supracervical hysterectomy is considered "new cancer." Lesions detected less than two years after the uterine operation are called "coincidental cancer," as it is felt that these were probably present at the time of surgery. Forty-two cases of true cervical stump cancer were treated between the years 1932 and 1947, with utilization of transvaginal roentgen therapy according to the author's previously described technic (Radiology **52:** 26, 1949) in 25. All of these cases have now been followed for five or more years or to death, with a five-year survival rate of 48 per cent for the whole series and 64 per cent for those treated transvaginally.

It is the author's conviction that overall prognosis in cancer of the cervical stump is at least as good as, and probably even slightly better than, that of the usual case of cervical cancer. His explanation is that patients who have had surgical procedures with interrupted menstrual cycles are more likely to report earlier to their physician for treatment of vaginal bleeding. A comparison with recently reported series of radium-treated cervical stump cancers indicates that results obtained in the author's small series are in the same general range as those obtained with radium therapy.

The complication rate was small in this group of 42 patients: 4 instances of minor to moderate bowel injury are mentioned, but it is not clear whether radiation was the etiologic agent. The author states that his newer type radiolucent transvaginal cones appear less likely to produce vaginal atresia and allow a much wider effective field of irradiation at the vaginal vault.

Four tables. J. W. BARBER, M.D.
Cheyenne, Wyo.

The Management of Carcinoma of the Corpus. James A. Corscaden and Harold M. M. Tovell. Am. J. Obst. & Gynec. **68:** 737–756, September 1954.

This report from the Sloane Hospital for Women (New York) covers a period—1938–48—when the standard form of treatment of carcinoma of the corpus uteri in that institution was intracavitary radium therapy followed by hysterectomy. Of 251 cases of corpus carcinoma seen in that time, 5 were not treated. Of the 246 remaining patients, 57 were treated by intracavitary radium application with or without subsequent x-ray therapy; 62 were operated upon with or without postoperative roentgen irradiation; 127 received radium therapy followed by hysterectomy. The authors present two series of results, one based on the assumption that all patients not followed are dead and the other, which is considered more valid, based on followed cases only. The latter shows 33.3 per cent of five-year cures with radium, 66.6 per cent for cases treated primarily by operation, and 82.8 per cent for preoperative radium therapy followed by hysterectomy.

Comparing the results of operation alone and of operation preceded by radium therapy, it appears that early cases were cured by either method. In cases in which the lesion was apparently confined to the corpus and in those with adnexal metastases the two methods appeared about equally effective, with a surprisingly high number of five-year cures. Neither method was successful in cases of widespread disease. The discrepancy between these observations and their actual figures the authors explain by the large number of cases treated by the combined method in which the lesions were localized to the corpus. They analyze their findings at length and find themselves at a "statistical dead end," but they feel strongly that radiation greatly improved results in bulky carcinomas limited to the uterus.

Among the conclusions reached are the following: that cancer of the corpus remains localized in the uterus for a long time and early diagnosis is therefore most desirable; that 5 to 10 per cent of carcinomas are "very lethal," metastasizing before they become clinically evident; that the more anaplastic the tumor and the deeper the penetration into the myometrium, the more frequent the metastases and the higher the mortality; that cases showing no radiation response had a higher mortality than cases that showed a response.

Seven illustrations; 12 tables. R. L. EGAN, M. D.
Jefferson Hospital, Philadelphia

Teratoma Testis: Report of 100 Consecutive Cases. Jack W. Schwartz and Nicholas Mallis. J. Urol. **72:** 404–410, September 1954.

This study evaluates clinically a series of 100 consecutive malignant tumors of the testicle seen at Letterman Army Hospital between 1945 and 1952. The incidence of the various pathologic types was: embryonal carcinoma, 48 per cent; seminoma, 23 per cent; teratocarcinoma, 23 per cent; choriocarcinoma, 3 per cent; adult teratoma, 2 per cent; interstitial-cell tumor, 1 per cent. It is the authors' impression that arrested descent of the testicle is not a predisposing factor in the development of testicular tumor. The average age in the entire series was 28.7 years. Painless swelling was the most common symptom. There was an average delay of 7.5 months from the time the patient sought medical attention to the removal of the involved testis.

Ninety cases were treated by simple orchiectomy and postoperative irradiation. Eight patients had retroperitoneal node dissection plus postoperative irradiation. Two patients were admitted in a terminal state and received no therapy.

The histologic classification of a testicular tumor and extent of metastases are important in planning a course of radiation therapy. When metastases are confined to the retroperitoneal nodes below the level of the renal pedicles, a course of irradiation in which a tumor dose of 2,500 to 3,000 r (2,000 r in seminoma) is delivered through anterior and posterior opposing fields in three to four weeks may be considered satisfactory. With nodes at higher levels, irradiation of the mediastinum and left sternoclavicular area is carried out immediately following surgery, if the patient's condition permits, or the left sternoclavicular area is irradiated immediately and the mediastinum at a later date.

The authors believe that routine retroperitoneal node dissection does not materially alter the survival rates. They recommend this procedure only when cord struc-

tures histologically show tumor invasion without evidence of other metastases and when the tumor type is other than seminoma, interstitial-cell tumor, or choriocarcinoma. The rare interstitial-cell tumor is clinically benign and is not irradiated postoperatively.

The overall survival (less than one year to over five years) in this series was: seminoma, 90 per cent; embryonal carcinoma, 56 per cent; choriocarcinoma, none; teratocarcinoma, 52 per cent; teratoma, adult, 50 per cent; interstitial-cell tumor, 100 per cent.

The critical period in testicular tumor is the first two years. Well over 90 per cent surviving this period are "cured." The demonstration of metastases on admission does not offer a hopeless prognosis. Of the 39 patients in that category, 21 were alive at the time of the report, 11 over five years.

The major hope of reducing the high mortality of testicular tumors lies not in more refined surgical technics or in more powerful irradiation devices but in earlier diagnosis.

Six tables.

THEODORE E. KEATS, M.D.
University of California, S. F.

Tumors of the Testis: Analysis of 80 Cases. Gilbert J. Thomas and Arthur J. Bischoff. J. Urol. **72:** 411–423, September 1954.

A series of 80 patients with tumor of the testis is reported. The type incidence was: seminoma, 48.8 per cent; embryonal carcinoma, 26.3 per cent; teratocarcinoma, 20 per cent; miscellaneous 5 per cent. The authors conclude that trauma *per se* is not an etiologic factor in the development of these tumors, but that cryptorchism bears a real relationship. Ten of the 80 malignant lesions occurred in undescended testes.

The diagnosis of testicular tumor is discussed in detail. Results of hormonal assays as a diagnostic aid in this series were encouraging. The seroflocculation test was 90 per cent accurate. The treatment of this group consisted of orchiectomy and radiation therapy, but details of the irradiation technic are not given.

At the time of this report, 48 of the 80 patients were living and 29 had died, a mortality of 36 per cent. Three were lost to follow-up. The average survivals for the various histologic groups are: seminoma, seven years and four months; embryonal carcinoma, three years and five months; embryonal carcinoma and chorioepithelioma (1 case), two years and six months; teratocarcinoma, three years and eight months; leiomyosarcoma (1 case), three years.

Nineteen tables.

THEODORE E. KEATS, M.D.
University of California, S. F.

Chemotherapy of Leukemia, Hodgkin's Disease and Related Disorders. M. M. Wintrobe, G. E. Cartwright, Phaedon Fessas, Arthur Haut, and S. J. Altman. Ann. Int. Med. **41:** 447–464, September 1954.

This discussion of chemotherapy in Hodgkin's disease, acute and chronic leukemia, lymphosarcoma, and reticulum-cell sarcoma concludes with some observations as to the comparative value of the agents considered and radiotherapy.

"Radiation therapy is as valuable as any of the chemotherapeutic agents in the treatment of all the conditions listed except acute leukemia. In some conditions radiation therapy may be more effective than any of the chemical compounds which have been discovered so far. Thus, it has yet to be shown that the remissions induced by Myleran are comparable in duration to those which follow skillful radiation therapy. Again, radiation locally applied when no systemic therapy seems to be required has no counterpart in chemotherapy. Against these advantages must be weighed the convenience and smaller cost of chemotherapy and the discomforts of radiation sickness as compared with those of the drugs which may be used. In the last analysis, the most effective management of the disorders under consideration is to be found in the judicious use of the whole therapeutic armamentarium that is available."

The chemotherapeutic agents discussed are: nitrogen mustard, triethylenemelamine (TEM), Myleran (1,4-dimethanesulfonoxybutane), urethane, the folic acid antagonists, cortisone and ACTH, and 6-mercaptopurine.

Fourteen figures; 1 table.

Peritoneal Mesothelioma. Case Report. E. P. Pendergrass and Jack Edeiken. Cancer **7:** 899–904, September 1954.

The authors present a case of peritoneal mesothelioma occurring in a 50-year-old woman. The patient was followed from November 1946 to June 1949, during which period the lesion responded to irradiation from time to time. Relief of pain and tumor regression was obtained on several occasions with tumor doses in the range of 1,750 to 3,000 r. After multiple courses of irradiation, during which time a total dose of 9,650 tissue roentgens was given, the tumor became refractory. During most of the period of observation the patient was in relatively good health.

The authors reviewed 10 other cases of peritoneal mesothelioma from the literature and found no instance in which irradiation was attempted, even in the presence of intolerable pain or recurring episodes of ascites.

One photomicrograph; 1 table.

RICHARD E. OTTOMAN, M.D.
University of California, L. A.

Pituitary and Orbital Roentgen Therapy in the Hyperophthalmopathic Type of Graves' Disease. Per Olof Gedda and Martin Lindgren. Acta radiol. **42:** 211–220, September 1954.

The authors cite further evidence that the exophthalmic feature of Graves' disease is ascribable to hyperfunction of the anterior pituitary. Clinical differentiation between the hyperophthalmopathic type of Graves' disease and the classic type is described.

A series of 19 patients were treated for hyperophthalmopathic Graves' disease. Eleven of these patients had undergone earlier thyroidectomy for hyperthyroidism and 6 gave a history of exophthalmos before the operation. Five of the 11 thyroidectomized patients still showed clinical signs of thyrotoxicosis.

Sixteen of the 19 patients received roentgen irradiation of the hypophysis and posterior orbits. Four small rectangular fields, each 5 × 6 cm., two on each temple, were arranged to center the pituitary fossa. The calculated dose to the sella turcica was 3,000 to 4,000 r delivered in a total period of sixty to ninety days. Ten patients so treated exhibited good results as manifested by disappearance of lacrimation, photophobia, and ophthalmoplegia. Chemosis and lid edema improved in most instances.

Six patients that did not respond favorably to pitui-

tary irradiation received direct treatment to the posterior orbits. A small lateral field was used on each side, so placed as to spare the lens. A calculated dose of about 1,200 r was delivered to the middle of the posterior orbits in sixty days. In 4 of the 6 cases there was satisfactory improvement. An interesting observation is that all 10 of the hyperthyroid patients became euthyroid as judged clinically.

The authors emphasize the importance of early diagnosis in hyperophthalmopathic Graves' disease, for much better results are obtained with radiotherapy in acute cases. Chronic or long-standing exophthalmos seldom showed marked benefit. It is felt that thyroidectomy, thiouracil compounds, and roentgen therapy directed to the thyroid gland are all contraindicated in this condition.

Two drawings; 2 tables. J. W. BARBER, M.D.
Cheyenne, Wyo.

Combined Treatment with Roentgen Rays and Streptomycin in Experimental Tuberculous Lymphadenitis in Guinea-Pigs. C. Åhlander. Acta radiol. **42**: 196–204, September 1954.

The author reports on a small series of animals infected experimentally with tuberculosis in the groin and treated with subcurative doses of streptomycin (1.0 and 2.0 mg.) in conjunction with roentgen irradiation.

The theoretical basis for the treatment is that roentgen rays induce a hyperemia which should raise the streptomycin levels in the local lesions. In addition, the radiation induced fibrosis about the lesions would constitute a barrier to further spread. Histologic findings demonstrated more fibrosis and less caseation in the lymph nodes of the animals treated by the combined method than in untreated controls and those treated only with streptomycin.

The series is too small for definite conclusions, but the author feels that the histologic findings give some support to the treatment of tuberculous lymphadenitis with irradiation and streptomycin.

Two photomicrographs; 5 tables.
ALBERT R. BENNETT, M.D.
Mt. Sinai Hospital, Cleveland

A Study of Lymphoid Tissue of the Nasopharynx. Philip E. Meltzer. Ann. Otol., Rhin. & Laryngol. **63**: 607–619, September 1954.

The author presents a survey of the literature regarding nasopharyngeal lymphoid tissue from the standpoints of histology, physiology, anatomy, pathology, and endocrinology, and voices his opinion concerning the role of surgery and irradiation in the treatment of lymphoid hyperplasia. He holds no brief for irradiation, though he recognizes its value in the treatment of scattered lymphoid tissue that evades even the most thorough surgery. He prefers x-ray therapy to radium because of the difficulty of accurately positioning the radium in view of the wide anatomical variations of the nasopharynx. He states, however, that he has never seen a mass of lymphoid tissue resolve following the use of x-rays. The effect of radiation is on secondary nodules of hyperplasia. Cessation of proliferative activity and removal of destroyed cells are followed, depending on dosage, by return of proliferative power. It is because of the consequent regeneration that irradiation can never replace surgery for removing scattered lymphoid tissue. Moreover, surgery has the advantage of removing the mass of lymphoid tissue, whereas irradiation simply inactivates lymphocytes and reduces edema by increasing blood flow.

The management of lymphoid regrowth as conducted by the author is outlined as follows:

(1) If hearing is impaired as a result of tubal closure following upper respiratory infection but has returned to normal after one or two inflations, the obstructing lymphoid tissue is surgically removed and no other treatment is given. Should tubal occlusion again recur after an upper respiratory tract infection, with the nasopharyngeal vault free of lymph nodules, irradiation is advised (600 r in three treatments; 100 r to each side through an intraoral cone or over the lateral neck).

2. If there is a history of recurring tubal closure without upper respiratory tract infection, and if lymphoid tissue is present, thorough surgery is performed, followed by x-ray therapy within two weeks. If this fails, allergy studies are advised.

3. When there is a history of allergy but no response to allergic therapy is obtained, the lymphoid tissue is surgically removed. The decision as to roentgen therapy depends on the postoperative course.

Four photomicrographs. F. F. RUZICKA, M.D.
St. Vincent's Hospital, N. Y.

The Future of Rotation Therapy. Rotational Irradiation of Patients with Deep-Seated Tumors. D. W. Smithers. Strahlentherapie **95**: 79–88, September 1954. (In German)

Rotation therapy is an effective method for irradiation of deep-seated lesions which are circumscribed, small, and well localized. The use of high energies increases the advantage of the procedure; the volume dose, absorption outside of the beam, and bone absorption are thereby decreased. For practical clinical work, energies above 2 to 5 Mev have no real advantage.

Rotation around the long axis, *i.e.*, revolution of the seated patient, with a stationary x-ray beam, has been used by the author mainly in brain tumors. It also improved the results in esophageal cancer in departments where energies above 200 kv were not available. It proved less useful for pulmonary cancer because of the danger of pneumonitis and fibrosis due to the large fields required. Owing to heterogeneous tissues in the chest, the spatial distribution of absorbed energy during rotational treatment is still uncertain. Measurements on a phantom and on persons who swallowed counters showed that the dose to the anterior chest wall may be double that received by the posterior wall.

Comparative measurements with different energies on a phantom of 30 cm. diameter showed that with a tumor dose of 5,000 r at 15 cm. depth, the skin dose was 3,000 r with 200 kv, 1,400 r with 2 Mev, 1,250 r with Co^{60}, and 650 r with 24 Mev.

In irradiation of other body parts than those mentioned above, rotation around the short axis results in better spatial distribution. Movements in two opposite directions may also be used in appropriate cases. Other types of convergent beams may serve the same purposes.

The Royal Cancer Hospital in London employed rotation with 2 Mev in the last three years, mainly on tumors of the brain, lungs, and bladder, with satisfactory curative and palliative results, without severe side effects.

In tumors nearer to the surface, the multiple-field technic remained the method of choice. In every case

the optimal technic should be selected individually, and it should be remembered that patients are treated by physicians and not by equipment.

Fourteen illustrations. LEWIS L. HAAS, M.D.
Chicago, Ill.

Indication for Moving Beam Therapy. Jens Nielsen and B. Jorgsholm. Strahlentherapie **95**: 41–48, September 1954. (In German)

The authors give a general review of the possibilities and advantages of rotational therapy, emphasizing homogeneous dose distribution in the tumor, steep decrease of dose in the healthy tumor bed, avoidance of undesirable field overlapping, and relatively small volume dose. The importance of careful continuous control of the rotational axis by fluoroscopy during irradiation is again stressed.

The method is especially useful in thoracic esophageal cancer. It offers advantages, also, in some cases of cancer of the lung, stomach, rectum, prostate, cervical esophagus, and oropharynx. It is contraindicated in the presence of regional nodes, since these require wider fields and the dose distribution with rotational therapy is favorable only with narrow fields.

Of 216 patients with thoracic esophageal cancer receiving a complete course of rotation therapy, 49 per cent survived one year, 24 per cent two years, 10 per cent three years, and 4.2 per cent survived five years. The palliative effects and prolongation of life were obvious. LEWIS L. HAAS, M.D.
Chicago, Ill.

Moving Field Irradiation through a Grid. A New Method of Roentgen Therapy. H. Hiltemann. Strahlentherapie **95**: 76–78, September 1954. (In German)

The author combines the advantages of grid and moving field therapy. He uses a grid made of lead strips 1 cm. wide and 1 cm. apart. In half of the grid the strips are placed reciprocally, in continuation of the free spaces of the other half. The tube rotates in the long direction of the strips.

The method permits an increase in the incident dose by reduction of the irradiated skin area, a decrease in the relative dose to the overlying tissue layers, and an increase in the depth dose, with homogeneous distribution in the lesion. Physical data as to the depth distribution are not reported.

Two illustrations. LEWIS L. HAAS, M.D.
Chicago, Ill.

Is Rotation Therapy with the Betatron of 15 to 31 Mev Energy Advantageous? H. R. Schinz and R. Wideröe. Strahlentherapie **95**: 33–40, September 1954. (In German)

Rotation therapy at 200 kv is superior to fixed beam irradiation for deep-seated tumors. The surface dose is distributed over a greater area, and damage to the skin and the superficial normal tissues is avoided, while a large cancericidal dose is delivered to the lesion. The high-energy betatron also has the advantage that the normal superficial tissues are not imperiled, because of the spatial depth distribution.

The authors compare betatron depth dose curves, obtained by cross-firing through two and three fields, with those of "pendulum" therapy. The curves of the cross-firing technic were found to be superior to those of the moving field therapy, in that the betatron beam in the body is sharply limited, while moving beam therapy delivers a higher dose to the neighboring normal tissues.

The sharply limited betatron beam is useful only if tumor localization and positioning of the patient are very accurate. Zuppinger assures this by combining with the betatron diagnostic roentgen equipment, the tube of which is installed in the betatron beam level, but accurate localization of the rotational axis would be very difficult in daily practice.

The two procedures with the betatron are basically different, and the combination of the two contrasting principles cannot produce an optimal result.

Six illustrations. LEWIS L. HAAS, M.D.
Chicago, Ill.

Investigation of Grid Fields with a Miniature Ionization Chamber. W. R. Bruce and H. E. Johns. J. Canad. A. Radiologists **5**: 29–32, September 1954.

Radiation therapy through perforated shielding gives rise to a very inhomogeneous dose superficially and a somewhat inhomogeneous dose distribution at a depth. Such a distribution has been found to make possible a more effective treatment of some tumors than conventional x-ray therapy. In order to investigate experimentally the grid fields, a small ionization chamber was built. The inside diameter of the air wall cap was 1.5 mm. and its length was 6 mm. The chamber could be moved remotely and its position indicated to 0.1 mm. Transits were made beneath a number of grids at depths of 1, 5, 10, and 15 cm. In addition a flat shallow chamber, 1 mm. deep and 3 mm. in diameter, was used for some studies.

Depth dose values have been calculated for a focal skin distance of 50 cm. The grids used for the calculation had openings of 1 cm. diameter at intervals of 1.4 cm., to give 40 per cent transmission. Square fields with areas of 50, 100, 225, and 440 sq. cm. were used. For each area the depth-dose at 1, 2, 5, 10, and 15 cm. is given, as compared with 100 r in air, for half-value layers of 1, 2, and 3 mm. of copper.

A comparison of the authors' theoretical calculations with those obtained by Loevenger's method (Radiology **58**: 351, 1952), gives good agreement at the center, although the maxima are slightly smaller and the minima slightly larger, a result of the non-uniformity of the scatter across the field.

Four illustrations; 1 depth dose table.
ALFRED O. MILLER, M.D.
Louisville, Ky.

RADIOISOTOPES

Therapeutic Studies in Hyperthyroidism. Use of Radioactive Iodine. Herman Stone, Boris Catz, Donald Petit, and Paul Starr. California Med. **81**: 4–6, July 1954.

One hundred and twelve hyperthyroid patients were treated with I^{131}. The average initial dose was 7 millicuries. The patients were observed for at least eight weeks to determine the effects, after which, if necessary, second and sometimes third doses were given, of equal amount or less.

One hundred and ten patients (98.2 per cent) were cured of their hyperthyroidism. One died of an un-

related cause before any effect of the treatment was evident, and the other gave up treatment. Nine patients had transient hypothyroidism and 12 had permanent hypothyroidism. Ninety-eight returned to a euthyroid state.

Of the treated patients, 69 had diffuse goiter, 33 nodular goiter, and 1 a substernal goiter; in 9 there was no clinical enlargement.

Treatment with the isotope was considered indicated in (1) patients past the age of forty, (2) those with recurrences following operation, (3) poor surgical risks, (4) those who refused surgery.

Dosimetry remains a problem not yet solved. Clinical judgment remains the best guide. The attempt was to deliver 100 to 120 microcuries of I^{131} per gram of thyroid tissue. Ninety patients received only one dose; 12 required two doses, and 10 required three or more doses.

PAUL MASSIK, M.D.
Quincy, Mass.

Simplified Sensitive Test for Thyroid Function, Using Protein-Bound I^{131}. L. Van Middlesworth, C. E. Nurnberger, and Alys Lipscomb. J. Clin. Endocrinol. & Metab. **14:** 1056–1061, September 1954.

The determination of the I^{131} content of precipitated plasma proteins has been applied as a diagnostic index of human thyroid function. This determination has been termed "conversion ratio," which indicates the percentage of plasma I^{131} in the protein-bound iodine fraction as compared with the total plasma I^{131}. The authors present a simplified and inexpensive method for determining conversion ratio. Formerly the major objection to this determination was the large dose of I^{131} required. This objection has been overcome by use of an inexpensive scintillation counter. The method and equipment used are described.

Results on 25 patients demonstrate that the conversion ratio as a single laboratory test for hyperthyroidism is as good as I^{131} uptake, if not more sensitive.

Two photographs; 2 tables.

THEODORE E. KEATS, M.D.
University of California, S. F.

Clinical Use of the Plasma Butanol-Extractable (Thyroxine) I^{131} in the Diagnosis of Hyperthyroidism and Myxedema. Alvin L. Schultz, Sol Sandhaus, Howard L. Demorest, and Leslie Zieve. J. Clin. Endocrinol. & Metab. **14:** 1062–1068, September 1954.

The present study was undertaken to evaluate the plasma butanol-extractable (thyroxine) I^{131} as a clinically useful measure of thyroid function and to compare it with plasma protein-bound I^{131} in the diagnosis of hyperthyroidism and myxedema.

The butanol-extractable (thyroxine) I^{131} and the protein-bound I^{131} levels in plasma twenty-four hours after administration of a tracer dose of I^{131} were studied in 50 euthyroid, 12 hyperthyroid, and 5 myxedematous subjects. The two measures are closely correlated. They separate euthyroid from hyperthyroid individuals very effectively but are not of value in distinguishing myxedematous patients. The ratio of butanol-extractable to protein bound I^{131} has no diagnostic value. The ratio of butanol-extractable to total plasma I^{131} is similar in discriminative effectiveness to the protein-bound I^{131} conversion ratio.

Two illustrations; 1 table.

THEODORE E. KEATS, M.D.
University of California, S. F.

Radioactive Isotopes in Management of Carcinomatosis of Serous Body Cavities. Edward M. Kent, Campbell Moses, William B. Ford, Eugene R. Kutz, and Robert S. George. Arch. Int. Med. **94:** 334–340, September 1954.

Since late in 1950, radioactive colloidal gold has been used in 163 patients by the authors in an effort to control malignant effusions. The indication for such treatment is intractable pleural or peritoneal effusion due to proved malignant disease.

Usually 100 mc of radioactive gold in isotonic saline is injected into the serous cavity at one time, precautions, in the form of lead shielding around the syringe, being used to protect personnel. In 44 per cent of cases more than the one dose was necessary, the second usually being given within three weeks after the first.

Evidence indicates that the beta ray is the effective factor, with an average penetration of about 1 mm. While the exact mode of action is still unknown, the available data suggest that diminution in the effusion is the result of superficial damage to the serous surface.

Of the 163 patients treated, 112 had intractable pleural effusions. The most common primary tumor sites were the lung and breast. Excellent results (only one injection needed to control the effusion) were obtained in about 46 per cent of this group.

Among the 51 patients with carcinomatous ascites, the ovary was the site of the primary lesion in 33. Sixty per cent of the 51 cases responded with excellent results to radioactive colloidal gold therapy.

Two illustrations; 6 tables.

RICHARD E. OTTOMAN, M.D.
University of California, L. A.

A Study of Radioactive Phosphorus Activities in Pleural Effusions. Robert E. Bauer, Irwin H. Moss, and Aubrey D. Richardson. Cancer **7:** 852–855, September 1954.

Using tracer technics, the authors established indices of P^{32} activity for various types of pleural effusions, the index being obtained by dividing the counts per minute in 1.0 c.c. of cell-free effusion by the counts per minute in a similar amount of plasma, and multiplying the result by 100.

Twenty hours after administration of 100 to 200 microcuries of radioactive phosphorus, specimens of pleural fluid and blood were obtained. After centrifugation, samples of the aliquots were dried in planchets and counted.

In a preliminary study of 8 patients with chronic inflammation, 5 with acute inflammation and 16 with effusions secondary to cancer, the following results were obtained: average P^{32} index in the first group 34.1, in the second group 56.0, and in the third group 79.4. There was a moderate overlap in the indices between the upper limits of Group 2 and the lower limits in Group 3. The index appeared to be independent of the total number of red blood cells, white blood cells, and the concentration of protein.

Two tables.

RICHARD E. OTTOMAN, M.D.
University of California, L. A.

Treatment of Carcinoma of the Bladder with Artificial Radioactivity. Use of a Liquid Radioisotope in a Balloon Catheter, with Special Consideration of a CO^{60} Solution. J. H. Müller. Radiol. clin. **23:** 285–303, September 1954. (In German)

The method of treating carcinoma of the bladder with

radioactive fluid in a balloon catheter was originated by the author. A true solution is used rather than a suspension in order to obtain a more homogeneous radiation effect. Cobalt-60 is particularly useful for this purpose, since about 96 per cent of its radiation consists of practically monochromatic gamma rays of more than 1.2 Mev, with only 4 per cent beta rays of 0.3 Mev, which are absorbed in a very thin layer of tissue.

The extreme advantage of the method described is the homogeneous spatial distribution of the radiation. This depends, of course, on the premise that the balloon be as nearly spherical as possible, though small departures from this, in accordance with the inner structure of the bladder, are not significant. This homogeneity of dosage distribution is difficult to achieve with those methods which use a point source of radium or metallic Co^{60} in the center of a balloon catheter filled with water or air, since a slight misplacement from the center results in a considerable alteration in the distribution of the radiation on the surface of the balloon.

A Bardex balloon catheter can almost always be introduced into the bladder through the urethra, without operation. Introduction in the female is simple; it may be more difficult in the male, because of a benign prostatic hypertrophy or a stenosis of the posterior urethra. However, preliminary progressive dilatation usually results in successful introduction. The capacity of the balloon catheter is 75 c.c. It is test-filled with 60 to 70 c.c. sterile water, mixed with a urographic contrast medium and methylene blue or indigo carmine, and allowed to remain for several hours to a day. If x-ray control proves satisfactory, and if the urine is not dye-stained, the balloon catheter is then filled with the radioactive cobalt chloride solution. In preparing this solution exact measurements must be obtained both as to fluid volume and radioactivity. For the former, calibrated flasks or special pipets are used; for the latter comparative measurements are made with an ionization chamber against 0.5 mm. of a platinum-filtered radium preparation (10 to 20 mg. radium element).

Cobalt solution with an activity of 20 to 30 mc. is used, in a single application. Only exceptionally is fractionation employed, as when the patient is not able to tolerate the treatment or when there is a threatened rupture of the balloon as indicated by a significant increase in urinary radioactivity.

In only a minority of cases can this method be used without previous surgery, such as resection of large papillomatous masses or partial cystectomy. The therapeutic results are definitely better in the relatively flat tumors, such as the papillomatoses and the papillary carcinomas, as compared with the more infiltrative transitional-cell carcinomas, undifferentiated solid carcinomas, squamous-cell carcinomas, adenocarcinomas, and sarcomas. Therefore, not only is the cystoscopic and physical examination of the tumor important for prognosis, but also its histology. Cases with massive perivesicular extension and regional metastases are not suitable for intravesical Co^{60} therapy, and these should be treated by total cystectomy or percutaneous irradiation, as with rotation therapy, high-voltage therapy, etc.

The postoperative care of the patient is important for prognosis. While about half of the patients who have been made tumor-free have few objective and subjective complaints, the remainder have severe bladder disturbances, such as a persistent chronic cystitis or superficial necrosis. Since bacterial infection probably plays a role in these complications, early and adequate treatment is indicated, especially during the first two years after Co^{60} treatment.

The author's three and one-half year results in 96 patients after treatment are presented statistically in a series of tables: Of 96 patients treated, 39, or 41 per cent, were tumor-free at the time of the report, 6 after more than three years. Eleven had been followed less than six months.

[An earlier report on this procedure, by Mayor (Schweiz. med. Wchnschr. **84:** 510, 1954. Abst. in Radiology **64:** 475, 1955) covered part of the material on which the present report is based.—C.V.C.]

One graph; 6 tables.

CHRISTIAN V. CIMMINO, M.D.
Fredericksburg, Va.

Localization of Radioactivity in the Urinary Bladder and the Regional Lymph Nodes. Harold F. Berg, Avrom M. Isaacs, and William M. Christophersen. J. Urol. **72:** 382–388, September 1954.

Animal experiments were performed with the hope of gaining information which might prove useful in the therapy of invasive bladder carcinomas. An attempt to develop a method of delivering an effective dose of radiation limited to the region of the urinary bladder and its lymphatic drainage was made by injecting radioactive colloidal gold into the wall of the urinary bladder in dogs. Five millicuries of Au^{198} in 5 c.c. of normal saline, to which 300 turbidity units of hyaluronidase had been added, was injected, and the animals were sacrificed at intervals of from five to fifteen days.

Concentrations of radioactivity were found to be consistently high at the site of injection, as well as in the trigone of the bladder and in the regional lymph nodes. Necrosis of the bladder wall occurred at the site of injection. Minor changes were noted in the regional lymph nodes. These results suggest that in patients with inoperable bladder carcinoma palliation might be obtained if a sufficiently large amount of isotope were utilized.

Three photomicrographs; 1 table.

THEODORE E. KEATS, M.D.
University of California, S. F.

Treatment of Prostatic Carcinoma with Radioactive Colloidal Chromic Phosphate (P^{32}): A Preliminary Report. Carl Rusche and Henry L. Jaffe. J. Urol. **72:** 466–475, September 1954.

Treatment of 28 cases of inoperable carcinoma of the prostate by radioactive chromic phosphate is reported. This is related to similar work by others using radioactive gold. The advantages of chromic phosphate are: longer half-life (14.3 days), absence of gamma radiation with resultant diminution in health hazard, and increased ease of handling.

No deleterious effects from the use of radioactive chromic phosphate have been observed as far as the general condition of the patient or the bone marrow is concerned. One and a half per cent of the injected material is excreted in the urine in twenty-four hours and only 1 per cent is excreted in the next six days. Thus, 97.5 per cent remains at the site of injection. Samples of blood and bone marrow failed to reveal any radiation activity. Very small amounts of radiation could be detected over the spleen, kidneys, and liver.

The injection technic is described in detail. Intravesical and perineal injections are made after opening the bladder. Obstruction of the bladder is relieved surgically. Approximately 0.3 to 0.5 mc are injected for each gram of tissue. The largest amount in any one case was 40 mc. Hyaluronidase and epinephrine are added to the isotope.

The results in this small group of cases have been encouraging. In 14 cases there was remarkable decrease in the size of the prostate and a definite change of consistency in thirty to sixty days. Fifteen patients experienced gain in weight and a general feeling of well-being. The microscopic findings in biopsy material are not as encouraging as the rectal and clinical findings. Tumor is evident in all biopsies. Radiation effects are apparent.

No serious complications have developed. Some patients with edema of the rectal wall have complained of bowel irritation. Mild bladder symptoms occurred in all patients. These discomforts subsided within thirty to forty days.

Eight photomicrographs; 2 photographs.

THEODORE E. KEATS, M.D.
University of California, S. F.

Intraprostatic Injections of Radioactive Colloids: II. Distribution within the Prostate and Tissue Changes Following Injection in the Dog. George J. Bulkley, John A. Cooper, and Vincent J. O'Conor. J. Urol. **72:** 476–484, September 1954.

This report is a continuation of work previously published. (J. Urol. **71:** 624, 1954. Abst. in Radiology **64:** 629, 1955). Ten dogs were given intraprostatic injections of colloidal chromic phosphate and 9 of colloidal gold. All organs were examined for radiation effect. The authors conclude that the injection of these materials into the prostate of the dog causes no appreciable radiation effect in distant organs. The only exception occurred in the case of the regional lymphatics following the injection of radiogold. These lymphatics were enlarged and in most cases hemorrhagic.

Distribution of the colloidal material was not uniform throughout the prostate, and in none of the animals was destruction of the normal prostate complete. Periprostatic reaction was marked with both the radiophosphorus and radiogold but more prominent with the latter.

The acute radiation reaction to radiophosphorus differs from that due to radioactive gold. The radioactive chromic phosphate caused an acute necrosis and hemorrhagic reaction with little exudative reaction. Radioactive gold, on the other hand, caused an acute exudative reaction with little necrosis or hemorrhage. The late reaction of tissue to the two materials was quite similar.

Lymph node changes were greater with radiogold, suggesting that this may be of advantage in cases of carcinoma of the human prostate with lymphatic spread.

Six photomicrographs; 1 table.

THEODORE E. KEATS, M.D.
University of California, S. F.

The Distribution and Radiation Effects of Intravenously Administered Colloidal Au^{198} in Man. Samuel W. Root, Gould A. Andrews, Ralph M. Kniseley, and Malcolm P. Tyor. Cancer **7:** 856–866, September 1954.

Intravenously administered colloidal radioactive gold produced no immediate clinical reactions in a series of 6 cases observed by the authors. The colloidal gold rapidly leaves the blood stream following injection. It is taken up, for the most part, by the reticulo-endothelial system, and its accumulation in an organ appears to be a function of the reticuloendothelial mass within that organ. Thus, most administered colloidal Au^{198} is found in the normal liver, where it becomes fixed, as indicated by the low bile activity. Neoplastic areas within the liver fail to take up Au^{198}. Uptake occurs also in the spleen and bone marrow and, in lesser amounts, in the lymph nodes, lung, kidney, and endocrine system.

The findings suggest that intravenously administered radioactive colloidal gold will not be an efficacious therapeutic agent for hepatic neoplasms, though the authors contend that their results do not exclude the possibility of treating very fine diffuse lesions.

Ten illustrations, including 4 radioautographs; 3 tables.

RICHARD E. OTTOMAN, M.D.
University of California, L. A.

Tissue Distribution of Injected Radioactive Colloidal Chromic Phosphate ($CrP^{32}O_4$). James B. McCormick, George Milles, Bertha Jaffe, and Lindon Seed. Arch. Path. **58:** 187–201, September 1954.

The experiments reported here were planned to accumulate data on the distribution and localization of colloidal chromic phosphate tagged with radioactive phosphorus ($CrP^{32}O_4$), with the ultimate purpose of exploring the possibility of using such a colloid suspension in the treatment of neoplasms by direct injection into the tumor. Two suspensions of chromic phosphate were used, one in which the particles varied from 2 to 4 μ in diameter and the other with particles with an average diameter of 0.2 μ. The colloidal particles were suspended in a 2 per cent pectin solution. The specific activity was such that 1 mc was carried on 10 mg. of chemical chromic phosphate. Four sets of experiments were performed to ascertain the fate of the radioactive substance injected into animals: (1) intravenous injection of $CrP^{32}O_4$ into rabbits and rats, (2) subcutaneous injections into the ear of the rabbit, (3) intramuscular injections into the pectoral region of rats, and (4) injections into the testis of the rat.

Radioactive colloidal chromic phosphate injected intravenously into rabbits and rats was found to be deposited to a large extent in the liver and spleen.

The mobility of particles injected subcutaneously into rabbits and interstitially into rats depends upon the size of the colloidal particles and the suspending medium. About a third of the dose reaches the liver when the particles are 0.2 μ in diameter and are suspended in saline. If the colloidal substance is suspended in a 2 per cent pectin solution, its mobility is significantly decreased. Particles of 2 to 4 μ have significantly less mobility and are to be preferred if local effects are desired.

The possibility of treating tumors by local injection of $CrP^{32}O_4$ is discussed and its promise pointed out.

Four photomicrographs; 5 charts; 4 tables.

Research on the Utilization of Radioactive PO_4Cr in Colloidal Solution for the Determination of Circulating Blood Volume. O. Jallut, L. Peguiron, R. Feissly, and S. Neukomm. Schweiz. med. Wchnschr. **84:** 1112–1113, Sept. 25, 1954. (In French)

Three methods of determining blood volume are:

(1) by the use of colloidal dyes such as Evans blue; (2) by non-radioactive red-cell-tagging agents such as carbon monoxide; (3) by radioactive agents used for tagging red cells or albumin. All of these procedures are based on the calculation of the dilution of a substance introduced in known quantity into the blood. When the rate of disappearance of these substances from the blood stream is plotted on curves, the following differences are noted:

1. The semilogarithmic curve of the rate of disappearance of the dyes is an inclined straight line.
2. The curve of disappearance of iodinated albumin is similar to that of the dyes but is more variable.
3. The disappearance curve of tagged red cells is more nearly ideal, in that it is practically horizontal during the first half hour after injection.

The colorimetric methods have been more simple to perform and usually take less time. It would be ideal to have a radioactive substance that is easy to prepare, that could be stocked readily and injected without danger, and would disappear slowly in exponential fashion. Studies with radioactive PO_4Cr have shown that it meets the first three of these requirements and that it does not undergo metabolic change. By differential centrifugation particles of 0.2 μ and 1.2 μ were obtained, and the curves of the rate of disappearance of these particles were determined after injection into rabbits. Each showed a rapid rate of disappearance during the first two to four minutes, which allows accurate determination of blood volume. The larger particles disappear twice as rapidly as the smaller particles. The curves for both sizes become more horizontal from eight minutes up to thirty minutes, the blood level of the smaller particles remaining higher. The rapid disappearance of the colloids precludes routine use for determination of blood volume.

One graph. CHARLES M. NICE, JR., M.D.
University of Minnesota

Geiger Counter Probe for Diagnosis and Localization of Posterior Intraocular Tumors. Charles I. Thomas, Jack S. Krohmer, and John P. Storaasli. Arch. Ophth. **52:** 413–414, September 1954.

In the past, some difficulty has been experienced in using radioactive phosphorus for the localization of posterior intraocular tumors because the posterior segment of the eyeball could not be satisfactorily reached by the counters available. A curved Geiger counter probe has now been constructed for the examination of this area. The instrument can be sterilized so that aseptic technic can be carried out in opening the conjunctiva and Tenon's capsule when applying the counter to the posterior portion of the globe. Preliminary studies on laboratory animals and limited clinical application have proved the instrument to be entirely satisfactory. Its use is recommended in cases of suspected tumors located behind the equator of the eyeball.

One photograph; 2 diagrams.

K-9: A Large 4π Gamma-Ray Detector. M. A. Van Dilla, R. L. Schuch, and E. C. Anderson. Nucleonics **12:** 22–27, September 1954.

A 4π gamma-ray detector is described which has been made sufficiently large to accommodate dogs (beagles). This counter is cylindrical in shape, with an inside diameter of 9 inches and a length of 28 inches. A liquid scintillating solution is contained in the wall of the cylindrical chamber. Four photomultiplier tubes are placed at either end of the cylinder to detect the fluorescence in the liquid resulting from the absorption of gamma rays.

The radioactive materials used in experiments with beagles were Ra-226, Ra-228, and Th-228. Each of these isotopes is distributed primarily throughout the skeleton of the animal.

Considerable attention was devoted to the choice of solvent and scintillator and the nature of the reflecting surface in the cylinder. The solvent used was triethylbenzene, and the scintillator consisted of diphenyloxazole and some additional alpha-naphthyl phenyloxazole, which displaced the emission spectrum in such a direction as to improve the reflectance. The sources were also employed inside a cylinder of Masonite, which simulated the absorption of the gamma rays by the animals. A plot of counting rate versus source position indicates that over a distance of at least 20 inches the counter was relatively insensitive to source position.

Some details of the successful application of this counter to dogs and rats are included.

Seven figures; 5 tables. JOHN S. LAUGHLIN, Ph.D.
Memorial Center, New York

RADIATION EFFECTS

Radiation Sickness: A Study of Its Relation to Adrenal Cortical Function and the Absolute Eosinophil Count. Elliott C. Lasser and K. Wilhelm Stenstrom. Am. J. Roentgenol. **72:** 474–487, September 1954.

A series of 40 women receiving roentgen therapy to the pelvis for carcinoma were observed for the development of radiation sickness and its relationship to adrenal function. Each patient received approximately 3,500 r to the mid-pelvis over a period of about twenty-eight days. During the treatment time adrenal function was studied as measured by the modified Thorn eosinophil response test, and the absolute eosinophil count in cells per cubic millimeter was determined. Each of the last 20 patients was evaluated as to severity of radiation sickness.

The authors found that adrenal cortical reserve, as measured by the modified Thorn ACTH-eosinophil four-hour response, fell to its lowest level—considerably below normal—at the end of ten to fourteen days of treatment. Further irradiation, however, did not prevent a gradual return of the index toward normal by the thirtieth to thirty-fourth day. The absolute eosinophil count showed a moderate drop in most patients after about the first week of treatment, and then climbed gradually to a point well above normal about twenty-five days after the institution of radiotherapy, with a subsequent fall toward normal. The "symptom index" (an arbitrary value obtained by questioning the patients with regard to frequency and severity of various radiation sickness symptoms) showed changes which paralleled fairly closely those in the absolute eosinophil count. For the group as a whole few or no symptoms were evident at the time of maximum adrenal cortical exhaustion as indicated by the Thorn test.

The authors conclude that the adrenal cortex undergoes a definite change during the course of pelvic ir-

radiation, but that this change is not necessarily, or even probably, related to radiation sickness. Re-evaluation of the sickness symptoms with regard to premenopausal and postmenopausal patients indicates that radiation sickness is likely to be more of a problem in women with low estrogen levels.

Recently published experimental data relative to changes in the adrenal cortex coincidental with radiotherapy are reviewed and discussed. An attempt is made to evaluate the interrelationships of radiotherapy and eosinophil levels. The authors feel that the demonstrated correlation between the eosinophil count curves and the "symptom index" curves in their patients indicates that both are a response to some common factor still undetermined.

Seven graphs; 3 tables. J. W. BARBER, M.D.
Cheyenne, Wyo.

Radiation Cancer. Report of 21 Cases. Olaf Petersen. Acta radiol. **42**: 221–235, September 1954.

After a brief review of the literature, the author analyzes 21 cases of radiation cancer collected from the Radium Center of Copenhagen and the Finsen Institute. These cases occurred during the years 1913 to 1952, during which period approximately 6,000 cases of spontaneous skin carcinoma were seen. Nineteen of the 21 cases were classified as "therapeutic radiation cancer" and 2 as "accidental," having been caused by early diagnostic roentgen procedures.

The cases are analyzed in considerable detail, with presentation of as much data relative to the radiation exposure as is possible. The author stresses the important observation that these malignant growths invariably appeared in areas of skin which showed unmistakable clinical signs of radiation damage, so-called "chronic atrophic roentgen dermatitis" (atrophy, induration, pigment disturbances, and telangiectasia). In 10 cases the cancer arose in a zone of chronic radiation ulceration.

The latent period between radiation exposure and development of skin cancer was long, averaging approximately twenty-five years. There appeared to be no correlation between the severity of skin changes and the length of the latent period. Nor was there any apparent relationship between the number of treatments and the length of the latent period.

All of the lesions for which irradiation was given were initially benign, and for the most part occurred in young individuals. The average age of onset of the radiation skin cancer was distinctly lower than that of spontaneous skin carcinoma. Histologically the series was about equally divided between basal-cell and "prickle-cell" cancer, with an occasional sarcoma.

The author points out that all of these patients received their radiation damage in the early days of radiology before accurate dose-determining methods were known. In the most recently reported case of the series, the radiation was given in 1923.

Treatment of radiation-induced cancer was mainly surgical, with excision and skin grafting. About half of the patients survived five or more years without evident recurrence. A small group died from unrelated diseases and about one-fourth died from cancer. Two selected cases in this group were treated with further radiation, and good results were obtained.

Eight photographs. J. W. BARBER, M.D.
Cheyenne, Wyo.

Common Hazards of X-ray Diagnosis in Urologic Practice: Their Recognition and Reduction. R. S. Clayton, Paul H. Goodman, and W. Leslie Bush. J. Urol. **72**: 569–572, September 1954.

The authors discuss the possibilities of injury from diagnostic roentgenography in the practice of urology. The following precepts are suggested to reduce the hazards to minimum levels:

1. Avoid exposure of technician and urologist to primary beam. When exposure is unavoidable, lead aprons and gloves should be worn.
2. Stay as far from the patient as possible during actual x-ray exposures.
3. Filter the primary x-ray beam with 2.0 mm. aluminum mounted permanently in the tube head. This reduces patient skin exposure about 75 per cent at medium kilovoltage. Scattered intensities will be reduced also.
4. Limit the primary x-ray beam with a lead diaphragm and employ cones.
5. Stay behind a radiation shield if inside the x-ray room during an exposure.
6. Check completeness of tube head protection against stray radiation. This can be done by surrounding the tube head with cassettes, closing the useful aperture with lead, and making an exposure.
7. Use high kv-, low mas technics to reduce exposure to patient.
8. Use dental film badges routinely.

If these safety practices are followed carefully, no harm to patients, physicians, or their assistants should occur.

Two illustrations. THEODORE E. KEATS, M.D.
University of California, S. F.

How Safe is X-Ray and Fluoroscopy for the Patient and the Doctor? Norman W. Clein. J. Pediat. **45**: 310–315, September 1954.

This paper on the hazards of radiation was read before the Seventh International Pediatric Conference, Havana, Cuba. Its recommendations are familar to all radiologists.

Seven tables.

RADIOBIOLOGY; RADIOCHEMISTRY

Physiologic and Histochemical Changes in Connective Tissue of Rat Induced by Total Body Irradiation. A. C. Upton and W. D. Gude. Arch. Path. **58**: 258–264, September 1954.

Whole-body ionizing irradiation has been observed to increase vascular permeability, which may be correlated with radiation-induced capillary fragility and hemorrhage. Irradiation has also been reported to enhance the permeability of the dermis to intradermally injected dye. The pathogenesis of these alterations is not understood, but it is conceivable that the vascular changes and the disturbances of dermal permeability are related. The authors' studies were undertaken to correlate, if possible, these two radiation-induced permeability phenomena and to search for associated morphologic abnormalities.

Wistar rats of both sexes, ten to fourteen weeks old, were divided into pairs of litter mates. One of each pair was given 750 r of whole-body irradiation, with the following factors: 250 kvp, 68 to 81 r per minute, 30 ma, 3 mm. Al filtration, target-skin distance 90 cm. After irradiation, 0.05 ml. of 0.5 per cent Evans blue in distilled water was injected intradermally into irradiated and control rats in corresponding areas of dorsal skin. Injections were begun on the day of irradiation and performed at intervals throughout the first thirty days after exposure. Only one test was performed per rat.

The dye was found to spread more rapidly and more widely in the irradiated rats than in the non-irradiated controls. The radiation-induced permeability of the dermal connective tissue appears four to seven days after irradiation and persists for from two to three weeks, the period coinciding with that of increased vascular permeability and purpura.

The heightened permeability of the dermis is associated with increased stainable acid polysaccharide in the ground substance of the dermis and panniculus, as indicated by the Hale stain, and with reduction in the number of mast cells in the dermis.

Five photomicrographs; 2 charts; 2 tables.

On the Pathogenesis of Bone Marrow Injury in Rats Subjected to Total Irradiation with Fast Electrons (15-Mev Siemens Betatron). R. Stodtmeister and M. Th. Fliedner. Schweiz. med. Wchnschr. **84:** 1113–1114, Sept. 25, 1954. (In German.)

Adult rats weighing 220 to 300 gm. were given single doses of total-body irradiation of 800 r, and changes in the blood were observed, with special reference to the granulocytic series. Immediately after irradiation, mature granulocytes in the peripheral blood rose from an average of 3,000 to 16,000 per cubic millimeter. This corresponded to a decrease of these cells in the marrow. The fall in peripheral granulocytes that followed the initial rise reached a maximum after seventy-two hours. After this, a slow increase ensued, both peripherally and in the marrow.

Edema in the bone marrow appeared to be of significance in the pathogenesis of the changes in the granulocytes. The edema was not limited to the bone marrow but was seen also in the mucosa of the intestinal tract, associated with bloody diarrhea, and within the liver, with a weight gain of 30 to 40 per cent after twenty-four hours. The edema in the several organs occurred at the same time as the bone marrow changes.

One graph. CHRISTIAN V. CIMMINO, M.D.
Fredericksburg, Va.

Malignant Transformation of Squamous Epithelium. A Cytochemical Study with Special Reference to Cytoplasmic Nucleic Acids and Proteins. Gunnar Moberger. Acta radiol. Supplement 112, 1954.

The author studied the changes in concentration of nucleic acids and proteins during "malignant" transformation of squamous epithelium, trying to determine differences in the physical-chemical nature of the cancerous as opposed to normal squamous elements. The observations were performed with the aid of fluorescent microscopy and roentgen absorption spectrophotometry. Whenever possible, comparative analyses were made between frozen dry and fixed tissue.

The experimental material consisted of methylcholanthrene-induced carcinomas and precancerous vaginal mucosa and epidermis of mice. The clinical material included various types of epidermoid carcinomas, non-neoplastic proliferating epidermis, and precancerous hyperplastic epithelium.

Decrease of cytoplasmic proteins was noted during the early phases of the malignant transformation of the vaginal epithelium of the mouse. In well developed carcinomas, an increased concentration of the cytoplasmic nucleic acid was found, especially remarkable in the peripheral layers of the infiltrating tumor. Similar findings were noted in analogous conditions involving the mouse epidermis.

Significantly increased concentration of nucleic acids was also noted in rapidly growing human epidermoid carcinomas as compared with normal or hyperplastic non-neoplastic epithelium.

The principles and methods of roentgen and ultraviolet absorption spectrophotometry are discussed and a detailed description is given of the procedures used in the investigation.

[The problem of the reversibility of the above described cytochemical changes has not been elaborated.—R.G.O.]

Forty-nine photomicrographs; 5 photographs; 13 charts; 13 tables. R. G. OLIVETTI, M.D.
Newington, Conn.

Cytochemical Changes in Lymph Nodes and Spleen of Rats after Total Body X-Radiation. G. Adolph Ackerman, Nicholas C. Bellios, Ralph A. Knouff, and Walter J. Frajola. Blood **9:** 795–803, August 1954.

The spleen and cervical lymph nodes from 127 young adult male albino rats variously treated were examined cytochemically. Fifty-six of the animals received 600 r total body radiation (LD 50/30) in a single exposure (250 kvp, 0.5 mm. Cu and 1.0 mm. Al filtration, at 100 cm. distance). Lymph nodes and spleen were removed at two, four, and twelve hours and one, two, four, eight, sixteen, and thirty-two days following irradiation. Ten animals served as controls. Thirty-four, 29, and 8 received aminopterin, nitrogen mustard and triethylene melamine, respectively, in dosage equivalents of LD-50 or greater.

Marked cytochemical changes were observed in the cells of the lymph nodes and spleen in periods of two hours to thirty-two days following irradiation. The intensity of the cytochemical reactions for pentosenucleoprotein, protein-bound sulfhydryl groups and alkaline phosphatase decreased within two hours after irradiation. This decrease occurred very rapidly and preceded any discernible morphological change. The cells that survived exhibited an increase in intensity of these reactions between twelve hours and four days following irradiation.

Observation upon the lymph nodes and spleen following a single injection of the chemical agents revealed no cytochemical changes prior to discernible morphologic alterations. Triethylene melamine produced more damage to the lymph nodes and spleen than did nitrogen mustard; very few changes were noted, either morphologically or cytochemically, following aminopterin, although bone marrow destruction appeared to be extensive. Lymphocytes were the only cellular elements which appeared to be damaged by the chemical agents.

Six photomicrographs. J. F. WEIGEN, M.D.
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